MIL-S-901C(NAVY)
AMENDMENT - 1
5 September 1963

MILITARY SPECIFICATION

SHOCK TESTS, H.I. (HIGH-IMPACT); SHIPBOARD MACHINERY,
EQUIPMENT AND SYSTEMS, REQUIREMENTS FOR

This amendment forms a part of Military Specification MIL-S-901C(NAVY), 15 January 1963, and has been concurred in by all interested bureaus of the Navy Department.

Page 16, paragraph 6.3: Delete and substitute:

"6.3 Test record.- For shock tested equipment the applicable test record form is NAVEXOS 3373, Factory Test Record, HI Shock. Pads of these forms may be obtained upon application to the Government inspector, except that activities of the Department of Defense should make application to the Naval Supply Center, Norfolk, Virginia and the Naval Supply Center, Oakland, California."

Pages 17 through 31, top of each page: Delete "MIL-C-901C(NAVY)" and substitute "MIL-S-901C(NAVY)."

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MILITARY SPECIFICATION

SHOCK TESTS,H.I.(HIGH-IMPACT); SHIPBOARD MACHINERY, EQUIPMENT AND SYSTEMS, REQUIREMENTS FOR

All interested bureaus of the Department of the Navy have concurred in the use of this specification.

1. SCOPE

1.1 Scope.- This specification covers the shock testing requirements for shipboard machinery, equipment and systems which are required to resist High Impact (HI) mechanical shock. The requirements are for the purpose of determining the suitability of machinery, equipment and systems for use under the effects of the severe shock which may be incurred in wartime service.

1.2 Classification.- Equipment and test classifications shall be of the categories specified in section 3.1 and as specified in the individual equipment specification.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-P-15024 - Plates, Identification ____ Information and Marking for Identification of Electrical, Electronic and Mechanical Equipment.
MIL-P-15035 - Plastic Sheet, Laminated, Thermosetting, Cotton-Fabric Base, Phenolic-Resin.
MIL-S-16113 - Steel Plate, Hull and Ordnance, Structural, Black (Uncoated) and Zinc-Coated (Galvanized) (Navy).

MILITARY (cont'd)

MIL-S-20166 - Steel, Bars and Shapes (for Hull Construction) (Including Material for Drop and Miscellaneous Forgings).

MIL-W-21157 - Weldment, Steel, Carbon and Low Alloy (Yield Strength 30,000-60,000 P.S.I.).

MIL-E-22200/1 - Electrodes, Welding, Mineral Covered Iron-Powder, Low Hydrogen Medium and High Tensile Steel as Welded or Stress-Relieved Weld Application.

STANDARDS

MILITARY

MIL-STD-8 - Dimensions and Tolerances.
MIL-STD-9 - Screw Thread Conventions and Methods of Specifying.
MIL-STD-10 - Surface Roughness, Waviness and Lay.
MIL-STD-19 - Welding Symbols.
MIL-STD-20 - Welding Terms and Definitions.
MIL-STD-22 - Welded-Joint Designs.

DRAWINGS

BUREAU OF SHIPS

10-T-2145-L - HI Shock Testing Machine, Light Weight
645-1973904 - Floating Shock Platform, General Arrangement and Details
NO807-655947 - HI Shock Testing Machine, Medium Weight

PUBLICATIONS

BUREAU OF SHIPS

NAVSHIPS 250-423-30 - Shock Design of Shipboard Equipment, Dynamic Analysis Method.
NAVSHIPS 250-423-31 - Shock Design of Shipboard Equipment, Interim Design Inputs for Submarine ad and Surface Ship Equipment.
NAVSHIPS 250-660-30 - A Guide for Design of Shock Resistant Naval Equipment.
NAVSHIPS 900-185 - Guide for the Design of Shock and Vibration Resistant Electronic Equipment.

NAVAL RESEARCH LABORATORY

Report 5618 - Navy High-Impact Shock Machines for Light Weight and Medium Weight Equipment.

DAVID TAYLOR MODEL BASIN

UNDERWATER EXPLOSIONS RESEARCH DIVISION

UERD Report 7-61 - Floating Shock Platform for Shock Testing Equipment Up to 30,000 Pounds.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications.- The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

NATIONAL BUREAU OF STANDARDS
Handbook H28 - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington 25, D.C.)

3. REQUIREMENTS

3.1 General requirements and definitions.- General requirements and definitions shall be as specified in 3.1.1 through 3.1.5.3.

3.1.1 Grades (see 6.1).-

3.1.1.1 Grade A.- Grade A items are machinery, equipment and systems essential for the safety and continued combat capability of the ship. Design shall be suitable to withstand shock loadings without significant effect on performance (see 6.1) and without any portion of the equipment coming adrift or otherwise creating a hazard to personnel or vital systems (see 3.2).

3.1.1.2 Grade B.- Grade B items are machinery, equipment and systems not required for the safety or continued combat capability of the ship. Design shall be suitable to withstand shock loadings without the equipment or any external portion of the equipment coming adrift or otherwise creating a hazard to personnel or vital systems.

3.1.2 Equipment classification (see 6.1).-

3.1.2.1 Hull mounted.- Hull mounted items are all machinery, equipment and systems or components thereof, located below the main deck and supported principally by the main structural members of the ship, including structural bulkheads. Items located on light platforms, decks or similar structure are excluded.

3.1.2.2 Deck mounted.- Deck mounted items are machinery, equipment and systems or components thereof located on main deck or above for surface ships and items located on light platforms, decks and non-structural bulkheads for all ships.

3.1.2.3 Shell mounted.- Shell mounted items are equipment or components thereof attached directly to shell plating below waterline.

3.1.2.4 Principal units.- Principal units are items of equipment or assemblies of equipments which are the major parts of a system such as diesel-generator sets,air conditioning plants, switchboards, radio transmitters, steam generators, missile launchers or larger valves directly supported by ships structure.

3.1.2.5 Subsidiary component.- Subsidiary components are items of equipment or assemblies of equipments which form a part of, or are supported on, a principal unit. These would include such items as the diesel engine of a diesel-generator set, the electric motor of an air conditioning unit, the power supply section of a radio transmitter, a switchboard circuit breaker, items which are attached to the steam generator or a valve supported by the attached piping and similar items.

3.1.2.6 Subassemblies.- Subassemblies are parts or groups of parts of a subsidiary component or a system. This would include such items as thermometers, individual gages or meters, relays, resistors, and similar items. The distinction between subassembly and assembly or part as used herein may be different than that used in various equipment specifications. As used herein it is the smallest breakdown of a complete system which may be accepted as a separate unit under this specification.

3.1.3 Classes (see 6.1).-

3.1.3.1 Class I.- Class I equipment is defined as that which will perform its specified functions, under HI shock, without the use of either external or internal resilient mountings.

3.1.3.2 Class II.- Class II equipment is defined as that which will perform its specified functions, under HI shock, with the use of resilient mountings which are allowed or required by the individual equipment specification.

3.1.3.3 Class III.- Class III equipment is defined that which has shipboard applications both with and without the use of resilient mountings and is therefore required to meet both class I and class II requirements.

3.1.4 Test classification (see 6.1).-

3.1.4.1 Lightweight.- The lightweight test (see 4.2.3.1 and 4.2.4.1) is applicable to items weighing approximately 250 pounds or less (see 4.2.4.1.2).

3.1.4.2 Medium weight.- The medium weight test (see 4.2.3.2,4.2.4.1.2 and 4.2.4.2) is applicable to items weighing approximately 250 pounds to 6000 pounds. (The total weight of equipment and test fixture shall not exceed approximately 7400 pounds).

3.1.4.3 Heavy weight.- The heavy weight test (see 4.2.4.3) is applicable to items weighing approximately 6000 pounds to 30,000 pounds. Under certain circumstances heavier loads are possible (see 4.2.3.3).

3.1.5 Types (see 6.1).-

3.1.5.1 Type A.- Type A test is a test of a principal unit (see 3.1.2.4). The type A test is a preferred type of test and shall be specified whenever a testing facility or machine of sufficient capacity is available.

3.1.5.2 Type B.- Type B test is a test performed on a subsidiary component (see 3.1.2.5) and shall be performed for those cases where a testing machine or facility of sufficient capacity to perform a type A test of the principal unit is not available. A type A test may be required in addition to a type B test of the components as specified in the applicable equipment specifications. Inasmuch as a type B test applies to subsidiary components having specific applications, approval will be limited to the specific application.

3.1.5.3 Type C.- Type C test is a test of subassemblies (see 3.1.2.6) having a variety of shipboard applications. A subassembly approved under type C test may be used aboard ship, subject to any limitation specified in the approval letter. Shock tests of a principal unit shall be required even though all subassemblies of the unit have successfully passed type C testing. Any requests for waivers of this requirement together with assembly and mounting details of the components and supporting structure and suitable analysis shall be submitted to the bureau or agency concerned for approval.

3.2 Basis of acceptability.(see 6.1).-

3.2.1 Acceptability shall be based on machinery, equipment and system behavior during or following the specific tests in accordance with the requirements of the particular grade of shockproofness specified (grade A or B). Unless otherwise specified acceptance shall be based on the requirements of grade A (see 3.1.1.1). For grade A items where the minimum acceptable performance is not specified the requirements following the test shall be the same as those prior to the test.

3.2.2 Extension of shock tests.- Action concerning previous acceptance of an item may be extended to cover another providing that it can be clearly shown that the original item was subjected to shock tests and successfully passed and that the design of the untested equipment, its intended services and shipboard installation are such as to result in an equal or better degree of shock resistance (see 6.2). Request for extension action, together with supporting evidence, shall be submitted to the bureau or agency concerned for approval. A design which has been approved by extension action shall not be used as a basis for further extension requests.

3.2.2.1 Extension of previously accepted items.- Items previously accepted in accordance with the requirements of the previous issue of this specification may be extended for acceptance under the requirements specified herein by meeting any additional testing specified herein.

3.3 Marking.-

3.3.1 Note for drawing.- Equipment which meets the requirements specified herein and has been approved as being of HI shock design shall include the following marking on the assembly drawing for the equipment.

(a) Shockproofness grade A or B.
(b) Basis of acceptance (shock tests on light weight, medium weight machine or floating shock platform, shock tests extended by letter _____, and so forth.
(c) If shock tested the following additional information shall be provided:
  (1) Type of mounting fixture used (for example), fixture 4A as shown on figure 5, fixture 4C as shown on figure 6, and 30-degree mounting as shown on figure 10, and other types of mounting fixtures.
  (2) Equipment class (class I, II or III with _____ (external or internal) resilient mountings).

3.3.2 Marking on equipment using resilient mountings.- For class II and III when using external mounts, the Federal Stock number (FSN) (or commercial designation if FSN not applicable) of the intended mount shall be indicated at a location adjacent to each mount. The marking may be accomplished by a separate plate conforming to MIL-P-15024. This marking shall read as follows:

"Mount No. _____(Federal stock no. or commercial designation) only is to be used in this location"

4. QUALITY ASSURANCE PROVISIONS

4.1 General quality assurance provisions.- Machinery, equipment and systems which are within the weight and space capacity of shock testing machines or facilities shall be demonstrated to be acceptable by shock testing or extension of shock tests in accordance with the applicable procedures of this specification.

4.2 Shock testing.-

4.2.1 Standard Navy shock testing machines.- Shock testing machine for light weight, medium weight and heavy weight equipment shall be as follows:

(a) Light weight equipment.- Shock testing machine shall be as shown on figure 1.
(b) Medium weight equipment.- Shock testing machine shall be as shown on figure 2.
(c) Heavy weight equipment.- Shock testing machine shall consist of a floating shock test platform as shown on figure 3.

4.2.2 Design of test fixtures.-

4.2.2.1 Type A.- For type A tests, the principal unit to be tested shall on the shock machine or floating shock platform in a manner simulating the most severe (as regards shock) service condition and method that can be used aboard ship (see 6.1). This mounting fixture shall be specified in the individual equipment specification. Means provided for securing the apparatus when installed on shipboard, shall be used in mounting the apparatus for the shock test.

4.2.2.2 Type B.- For type B tests, the subsidiary components shall be mounted in a manner which is approved by the bureau or agency concerned, as being dynamically equivalent to the mounting provided when they are assembled to form the principal unit. When a specific fixture design is not specified in the individual equipment specification the contractor shall provide a fixture for shock testing the component which will produce the same natural frequencies (plus 20 percent, minus 10 percent) as those present on the complete and installed principal unit. If alternate methods of attachment to the principal unit are possible then the test fixture shall be designed to simulate the most severe condition.

4.2.2.3 Type C.- Type C, subassemblies shall be subjected to shock tests only if they will have general applications. Such subassemblies shall be mounted on the test machine in the manner specified in the individual equipment specification or shall be mounted so as to simulate the most severe condition which may be encountered in service.

4.2.3 Methods of mounting (see 6.1).-

4.2.3.1 Light weight equipment.- The shock machine for light weight equipment is provided with the anvil plate as shown on figure 4. Unless otherwise specified in the contract or order, or the individual equipment specification, the apparatus to be tested shall be mounted by means of standard mounting fixtures 4A, 4C, 6D-1, 6D-2 or 6E as shown on figure 5 through 8 or a substitute approved by the bureau or agency concerned (see 4.2.2.2).

4.2.3.1.1 An item of equipment that has passed the shock test when mounted on fixture 4A or 4C as appropriate, need not be retested for applications where the fixture 6E mounting would ordinarily be required. For example, a switch that has passed tests on fixture 4A or 4C need not be retested on fixture 6E if it is to be utilized as a controller component. When an item of equipment has passed shock tests mounted on the fixture 6D or 6E, it shall be limited to applications for which these mountings are appropriate. Where a specific test fixture is designated in the individual equipment specification, the fixture shall be utilized in all instances unless exception is made by the bureau or agency concerned.

4.2.3.1.2 When the equipment has been mounted for a test upon a standard fixture, its position upon the fixture shall not be changed during the course of the test.

4.2.3.1.3 There shall be no variation in the construction of these standard fixtures without specific approval of the bureau or agency concerned. In the event that none of the standard fixtures can be utilized for a particular piece of equipment, or if there is some doubt as to which fixture is applicable, the bureau or agency concerned shall be consulted. It is the intent of these standard fixtures to approximate the actual rigidity encountered aboard ship in the utilization of the particular equipment.

4.2.3.2 Medium weight equipment.- The shock machine for testing medium weight equipment shall be as shown on figure 2. The equipment shall be attached to the anvil table of the machine by means of a fixture, as specified in 4.2.2. In general, the fixture should provide a stiffness approximately equivalent to the most rigid mounting on which the equipment would normally be placed aboard ship. The standard mounting platforms shown on figures 9-1, 9-2 and 10-1 and 10-2 are approved for use unless mounting adaptors differing from those shown are specified in the individual equipment specifications.

4.2.3.3 Heavy weight equipment.- If the location and characteristics of the shipboard structure are not known, or if several locations are possible, the equipment shall be installed in a manner to simulate the most severe condition likely to be encountered. The unit shall be attached to its foundation and test fixture for tests in accordance with the manufacturer's installation drawings. The upper weight limit of approximately 30,000 pounds (40,000 pounds at the San Francisco Naval Shipyard facility) is established for equipment on the floating shock platform and may be reduced or increased depending on the individual test installation as it affects the stability of the test machine.

4.2.4 Test procedure.- The apparatus or equipment shall be tested in each of the operating conditions specified in 6.1 for example, motors shall be tested running at rated speed and at standstill, and contactors shall be tested in the open and closed position and equipment shall be tested at design pressure. Directional test on the light weight and medium weight shock machines may be scheduled to minimize changes in test set-ups. Unless otherwise specified in the individual equipment specification, the procedure shall be as specified in 4.2.4.1 through 4.2.4.3.

4.2.4.1 For light weight equipment.-

4.2.4.1.1 A total of nine blows shall be applied, employing the machine shown on figure 1. Three blows shall be applied parallel to each of three principal axes of the apparatus being tested, the three blows for each direction to be with heights of hammer drop of 1 foot, 3 feet, and 5 feet. For light weight equipment having two or more electrical or mechanical operating conditions (for example, circuit-breakers and switches), the nine blows shall be delivered for each condition; separate items of equipment may be submitted for each series of nine blows if desired by the manufacturer.

4.2.4.1.2 Equipment within the range of 250 to 400 pounds may be tested on the light weight machine if specified by the bureau or agency concerned. Requests for HI shock tests on equipment in this weight range shall indicate whether tests are desired on the light or medium weight machine. A note shall also be incorporated on the applicable drawing indicating the shock machine utilized.

4.2.4.2 For medium weight equipment.- Tests for medium weight equipment shall be made on the medium weight shock machine shown on figure 2. The mode of equipment operation during the tests shall be as specified in individual equipment specification. A minimum of six blows shall be applied (see 4.2.4) consisting of three groups of two each. For each group, the height of hammer and the initial up travel of the anvil table shall be as shown in table I. One blow of each group shall be with the equipment mounted on an inclined orientation. The fixture used shall conform to the requirements specified in 4.2.3 and should be similar to the fixture shown on figure 10-1 or 10-2. Additional blows in each group may be required by the individual equipment specification to account for special modes of equipment operation or other mounting axis orientations.

Table I - Test schedule for medium weight shock machine.

Group number----------	I	II	III
Number of blows----------	2	2	2
Anvil table travel, inches----	3	3	1-1/2
Total weight on anvil table, [1] (Pounds)	Height of hammer drop [2] (Feet)		
250 - 1,000	0.75	1.75	1.75
1,000 - 2,000	1.0	2.0	2.0
2,000 - 3,000	1.25	2.25	2.25
3,000 - 3,500	1.5	2.5	2.5
3,500 - 4,000	1.75	2.75	2.75
4,000 - 4,200	2.0	3.0	3.0
4,200 - 4,400	2.0	3.25	3.25
4,400 - 4,600	2.0	3.5	3.5
4,600 - 4,800	2.25	3.75	3.75
4,800 - 5,000	2.25	4.0	4.0
5,000 - 5,200	2.5	4.5	4.5
5,200 - 5,400	2.5	5.0	5.0
5,400 - 5,600	2.5	5.5	5.5
5,600 - 6,200	2.75	5.5	5.5
6,200 - 6,800	3.00	5.5	5.5
6,800 - 7,400	3.25	5.5	5.5

[1]Total weight on anvil table is the sum of equipment weight plus weight of mounting.

[2]The height of hammer drop shall be measured by means of the existing markings on the scale of the machine, no corrections being made for the added anvil table travel for the blows of groups I and II.

4.2.4.3 For heavy weight equipment.- Tests for heavy weight equipment shall be conducted on the floating shock test platform shown on figure 3 Unless otherwise specified in the individual equipment specification, the test series shall consist of five shots using 60 pound charges suspended 24 feet below the water surface, at horizontal range of 60, 40, 30, 25, and 20 feet, from the near side of the platform. Requirements for equipment operation, orientation, inspection, instrumentation, and similar facilities, shall be as specified by the bureau or agency concerned. Navy Department, Bureau of Ships, Code 423, David Taylor Model Basin or the San Francisco Naval Shipyard may be contacted regarding use of these facilities.

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4.2.5 General test procedures.-

4.2.5.1 All mounting bolts of the test item and shock machine mounting shall be tightened before each blow only as necessary to compensate for the loosening due to seating in of the mating surfaces. Excessive bolt yielding or loosening shall be considered as cause for rejection.

4.2.5.2 The behavior of the equipment under test shall be recorded when and as specified by the bureau or agency concerned (see 6.1).

4.2.5.3 The test report prepared by the test activity shall include detailed descriptions of any damage incurred during each blow, and, where practicable, photographs showing the damage incurred should supplement this description. When equipment performance under test is monitored, as may be required by the applicable individual equipment specification, a copy of such records shall be included in the test report. In addition the overall dimensions, the weight, and the approximate location of the center of gravity of the equipment, together with a sketch or photographs of the method of mounting on the shock-testing machine, shall be recorded and shall be included in the report.

4.2.5.4 After completion of the shock tests, grade A machinery, equipment and systems shall be given suitable test to determine whether or not it performs its specified functions (see 6.1). For equipment on which hydraulic pressure tests are required such tests shall be made at the pressure specified for tests in the individual equipment specification. Grade B machinery, equipment and systems, shall be given sufficient tests to insure that as a result of the shock tests no personnel or other hazards are created such as serious steam leaks, release of toxic gases, electrical shorts or other hazards.

4.2.6 Disposition of shock tested equipment.- When a test sample has satisfactorily passed the shock test and is to be retained by the government, the manufacturer shall thoroughly examine the sample and correct all damage which may have occurred during the test. Upon completion of shock test a post-shock test examination and corrective measures as specified in the individual equipment specification shall be performed. Disposition of the test sample shall be as specified in the individual equipment specification.

4.2.7 Test records.- government and commercial test facilities.-

4.2.7.1 Form.- The results of shock tests shall be recorded on form NAVEXOS 3373 (see 6.3). A copy of the completed form together with copies of other required data shall be submitted by the testing facility to the ordering activity and to the bureau or agency concerned.

4.2.7.2 Acceptance report.- If the equipment passes the HI shock test satisfactorily, as determined by the Government reviewing authority or other reviewing authority, the equipment may be accepted as far as shock is concerned or referred to the procuring activity for action. A copy of the reviewing action, along with a copy of the test report, shall be forwarded to the procuring activity.

4.2.7.3 Rejection report.- If the equipment fails to pass the HI shock test satisfactorily, as determined by the Government reviewing authority or other reviewing authority, the manufacturer shall be so advised. The manufacturer shall then inform the procuring activity, via the Government reviewing authority or other authority, as to the proposed design changes which will correct the deficiencies. In certain cases the bureau or agency concerned may decide to accept the equipment as HI shockproof on the basis of the corrective design changes rather than to require retests.

4.2.8 Design guidance for shock tests.- Section 6.2 and the following documents provide useful information for the design and analysis of items which are required to pass shock tests. The application of this design guidance material shall not detract from or take precedence over successfully passing the test requirements specified herein.

(a) NAVSHIPS 250-660-30.
(b) NAVSHIPS 250-423-30.
(c) NAVSHIPS 250-423-31.
(d) NAVSHIPS 900-165-A.
(e) Naval Research laboratory Report 5618.
(f) UERD Report 7-61 (Explains general procedures and provides typical input motions).

5. PREPARATION FOR DELIVERY

5.1 This section is not applicable to this specification.

6. NOTES

6.1 Ordering data.- Procurement documents should specify the following:

(a) Title, number and date of this specification.
(b) Grade (A or B) of shockproofness required (see 3.1.1).
(c) Equipment classification (see 3.1.2).
(d) Classes required (see 3.1.3).
(e) Tests classification (see 3.1.4).
(f) Types required (see 3.1.5).
(g) Definition of "failure to perform specified functions".- (Define minimum acceptable performance of the equipment or component during and following shock test such as extent of

momentary malfunction if permitted, degree of permanent deformation if permitted, degree of permanent functional impairment allowed, maximum misalignment, operational checks after shock test such as meeting a specified hydrostatic test pressure, insulation breakdown tests, leakage rates, (see 3.2, 3.2.1 and 4.2.5.4).

(h) Method mounting equipment for test. - (Designate test fixture to be used, method of simulating reactions of attached loads such as piping connections and other external test if other than specified in this specification) (see 4.2.3).

(i) Mode of equipment operation during tests.- (Energized, de-energized or both, pressurized, rated speed or other operating conditions, special monitoring or other instrumentation required) (see 4.2.4 and 4.2.5.2).

(j) Disposition of shock tested samples.- (Deliver for use aboard ship, acceptable after specific repairs) (see 4.2.6).

(k) Exceptions to this specification.

(l) Number of individual articles from each manufacturing lot to be tested.

6.2 General information.-

6.2.1 The following information is listed herein for the assistance of the designer and, for the assistance of the bureau or agency concerned approving drawings prior to manufacture:

(a) All items have motion under shock. Nothing is "rigid" except in a relative sense.

(b) The relative deflection of components under shock can be quite large and accordingly there should be ample clearances and sufficient lead wire length, and so forth, to prevent electrical short circuits, collisio damage and broken or over-strained connections.

(c) Desirable material properties are strength, ductility (at least 10 percent elongation), and, in some cases, low density. Undesirable properties are brittleness, low impact resistance, and high notch sensitivity.

(d) In the application of material, ample cross sections should be provided and factors causing stress concentration such as sharp notches and sudden changes in cross section should be avoided.

(e) In the design of mechanisms (for example, voltage regulators and relays) well constructed hinges or shafts and bearings are preferred to knife-edge pivots.

(f) Levers, linkages and other moving parts of mechanisms should be dynamically balanced (either individually or in groups), whenever practicable, in order to reduce the tendency to mal-operate under shock. This is particularly applicable to such items as circuit-breakers, rotary solenoids, and relays.

(g) The cantilevering of components should be avoided since such mountings deflect excessively and can produce large stresses. Such arrangements can also lead to problems under shipboard vibration conditions. Adequate consideration should be given to the frequency relationship between the expected shock environment, the equipment on its foundation and internal or external components. Any condition of near resonance can be expected to produce excessive shock response and therefore should be avoided.

(h) Friction cannot be depended upon as a means for retaining relative position of components under dynamic loads. A positive means for holding, driving and positioning should be used in lieu of any frictional device regardless of its apparent static holding power.

(i) Components or assemblies which are designed to provide quick access or removal must have adequate means to provide secure lock-in and support when in their normal operating position.

(j) Bolted joints. Where bolts (cap screws, machine screws and studs are included), are installed in clearance holes the clearance should be minimized to properly share bolt shear loads and to reduce the effect of impacting due to load reversals under shock. The following is for general guidance:

Nominal bolt diameter	Maximum diameter of hole
3/4 inch and smaller	Nominal bolt diameter plus 1/32 inch
Larger than 3/4 inch	Nominal bolt diameter plus 1/16 inch

Where alignment must be maintained, fitted bolts or other positive methods should be used. All bolted joints tend to loosen under shock. Proper bolt design, sufficient pre-stress and adequate finishing and sizing of joint surfaces can eliminate or reduce this tendency. For joints employing "O" rings of similar sealing devices, proper bolt pre-stressing is essential to prevent the flanges from parting under shock, even momentarily, and the gasket being displaced (by action of the internal hydrostatic forces).

In general, bolts should be tightened (pre-stressed) to a maximum value consistent with the allowable stress, the effects of combined loads and operating conditions. Friction type lock nuts and similar locking devices may help to preserve the initial pre-stressing and will be of value towards minimizing the possibility of additional damage in the event the joint does become loose following shock loadings. Except for very small items of equipment, such as gages, mounting bolts less than 1/2 inch in diameter should not be used because of the inherent danger of overstressing during the initial or subsequent tightening. Reduced shank or hollow bolts increase the capability of the bolt to absorb energy, however, in almost every case of joint design it is desired to transmit energy rather than absorb it.

(k) Welding. When possible locate welded joints away from highly stressed areas. The effects of stress reversals must be considered in joint selection. Weld sizes should make allowance for corrosion, difficulty in welding, discontinuities and other factors which tend to reduce strength. The effect of heat on the material as a result of welding, especially aluminum and similar materials, should be determined and allowed for. The ability to perform weld inspections satisfactorily should be considered in the design of joints.

(l) Piping. Threaded pipe and fittings should be avoided. Where threaded connections cannot be avoided, flexibility should be provided to minimize the load on the threads. Flexibility should be provided in piping runs between different components or where they are attached to structures that can have relative movement under shock. The inertia effects of piping can be large and sufficient support should be provided so as not to over-stress or in some cases even elastically deform the equipment or associated valve or fitting excessively.

(m) Shock mounts. Shock mounts may be employed, based on a definite need, and only after a careful review of the design indicates that it is not otherwise feasible to meet the shock requirements. Where a need for shock protection is established, the mount characteristics should be determined based on a knowledge of the particular shock environment and the dynamic nature of the equipment. Mounts must also be compatible with other shipboard environments, such as vibration and service conditions, and as such should meet the requirements of MIL-M-17185.

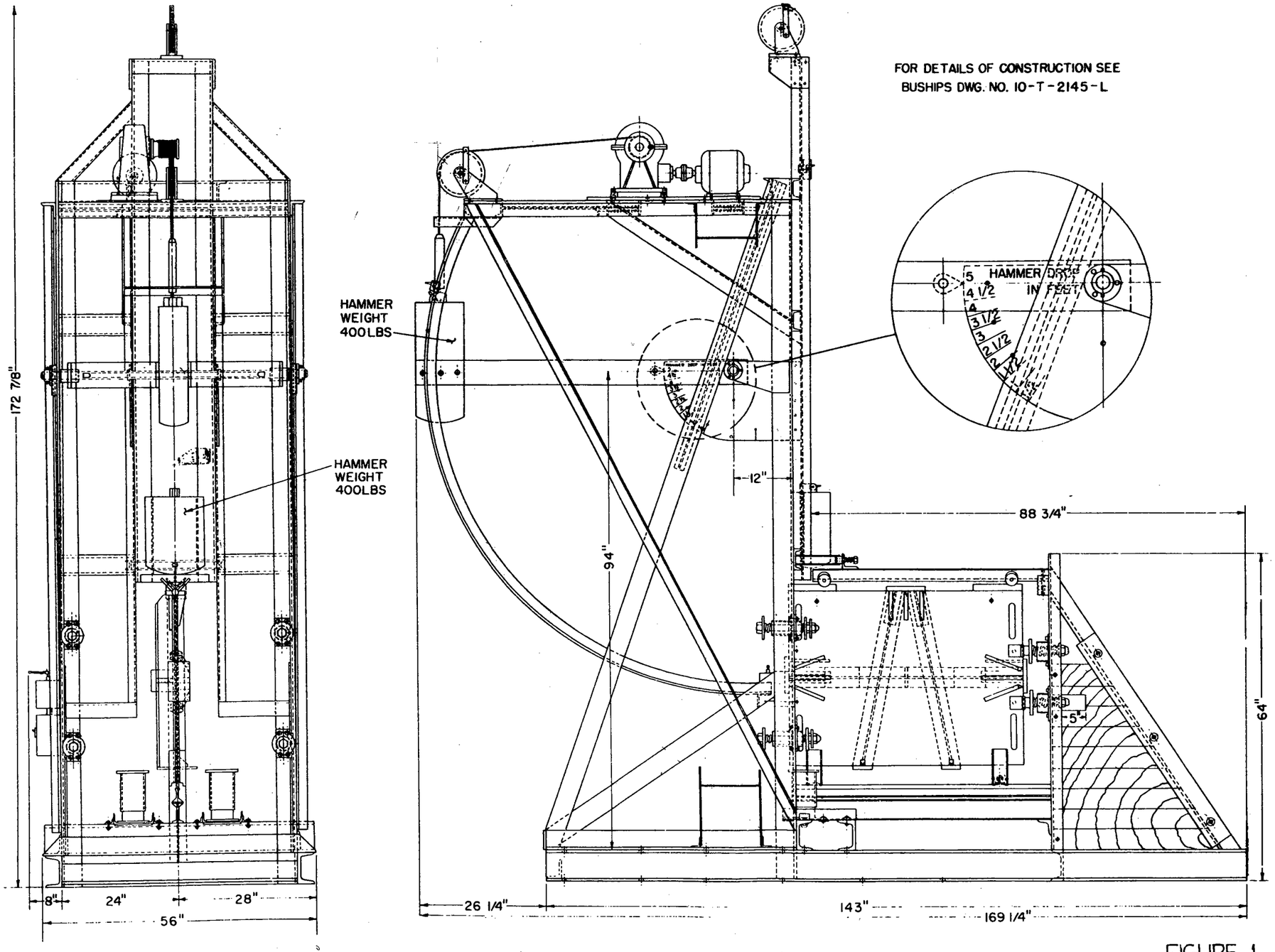
Most mountings have non-linear characteristics and their properties under normal loading often change radically with the large amplitudes and rates of loading encountered under shock. Mount deflection under shock, especially for base mounted equipment should be considered in specifying the clearances around the equipment and in the design of connections such as wave guides and similar connections. All mountings must have a positive, mechanical captive feature in their design.

6.2.2 This specification is very general so as to cover the entire field of shipboard machinery, equipment and systems. In order to apply this specification properly, it is necessary to specify separately, describe, or define the features enumerated in 6.1.

6.3 Test record.- For shock tested equipment the applicable test record form is NAVEXOS 3373, Factory Test Record, HI Shock. Pads of these forms may be obtained upon application to the Government inspector, except that activities of the Department of Defense should make application to the Commanding Officer, Naval Supply Depot, Philadelphia 20, Pennsylvania. When requesting forms refer to both the title and number.

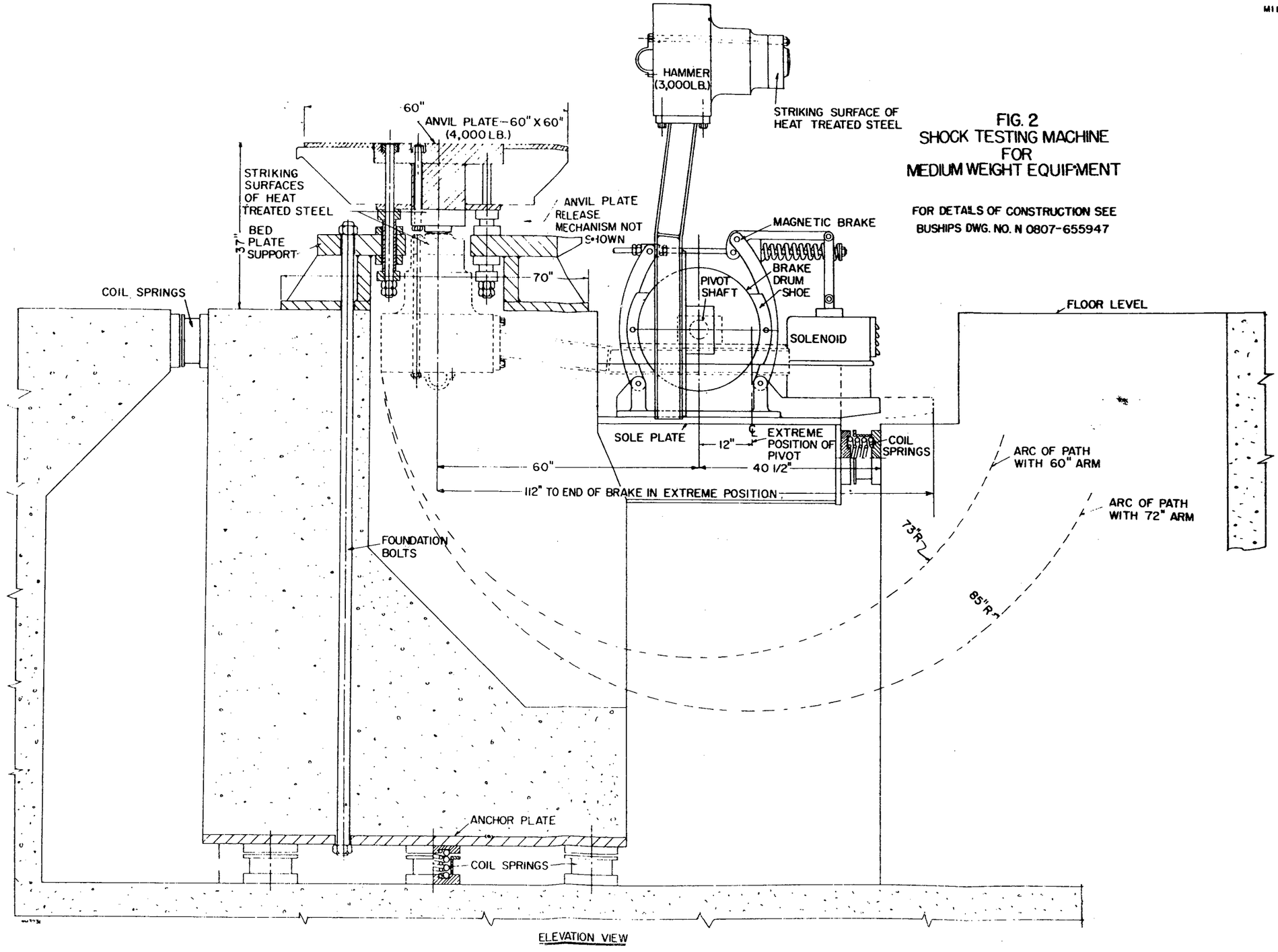
Notice.- When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Preparing activity:
Navy - Ships
(Project MISC-N013(NAVY))



SHOCK TESTING MACHINE FOR LIGHT WEIGHT EQUIPMENT

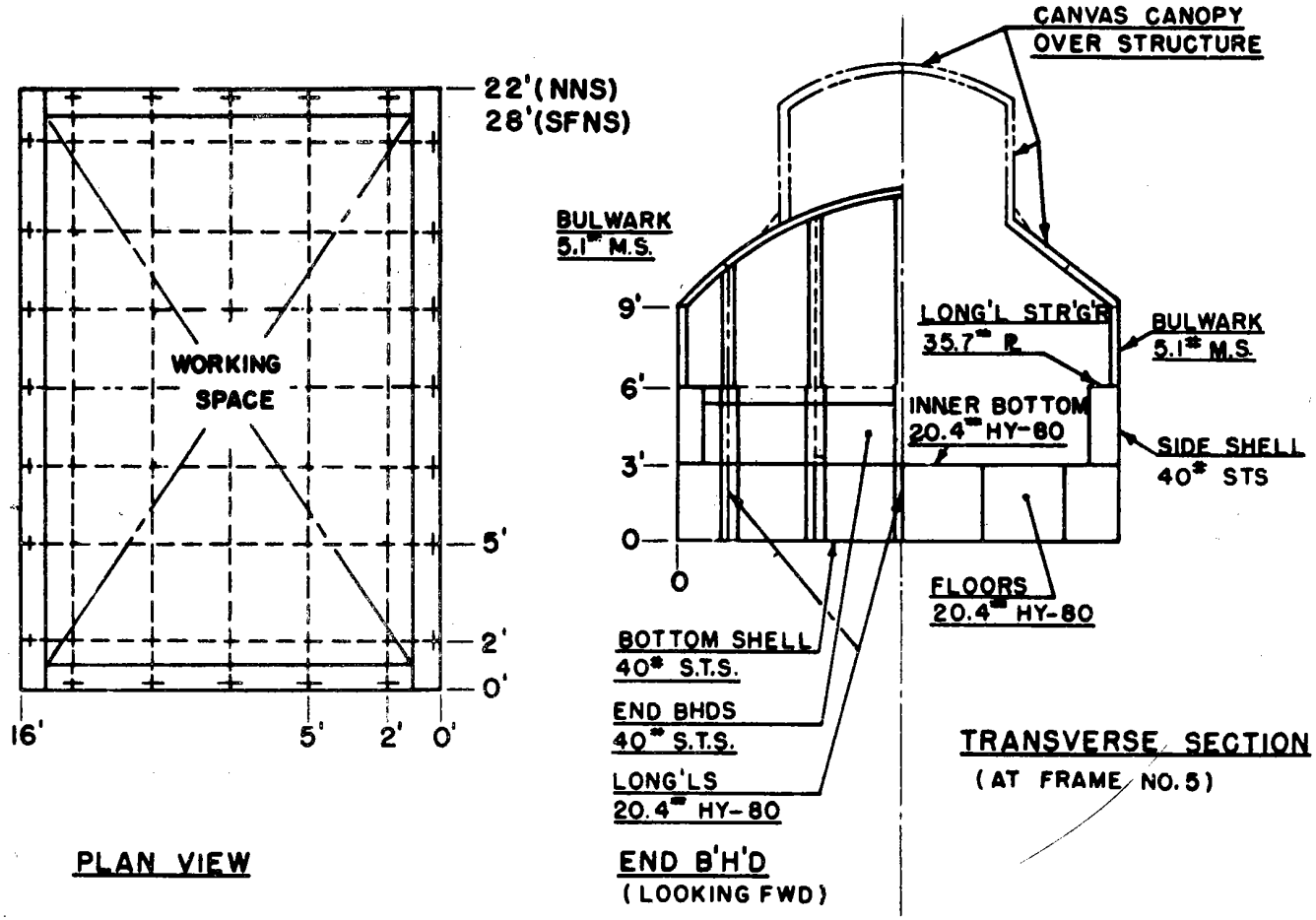
FIGURE 1



ELEVATION VIEW

FIG. 2
SHOCK TESTING MACHINE
FOR
MEDIUM WEIGHT EQUIPMENT

FOR DETAILS OF CONSTRUCTION SEE
BUSHIPS DWG. NO. N 0807-655947



FLOATING SHOCK TEST PLATFORM- FIGURE 3

SH 7349

(SEE BUSHIPS DWG. NO. 645-1973904 FOR CONSTRUCTION DETAILS)

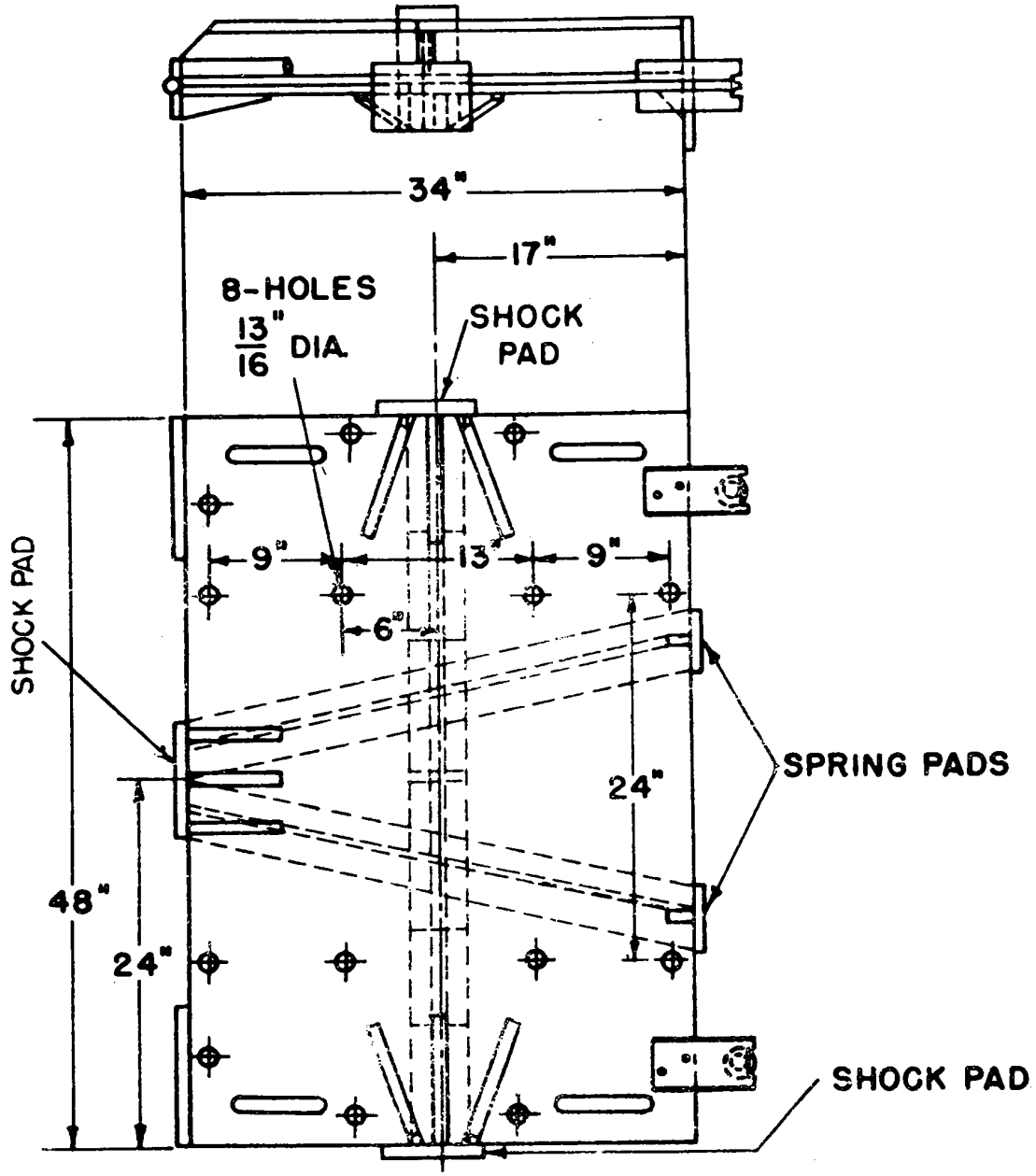


FIGURE 4.- ANVIL PLATE OF SHOCK-TESTING MACHINE FOR LIGHTWEIGHT EQUIPMENT

SH 735

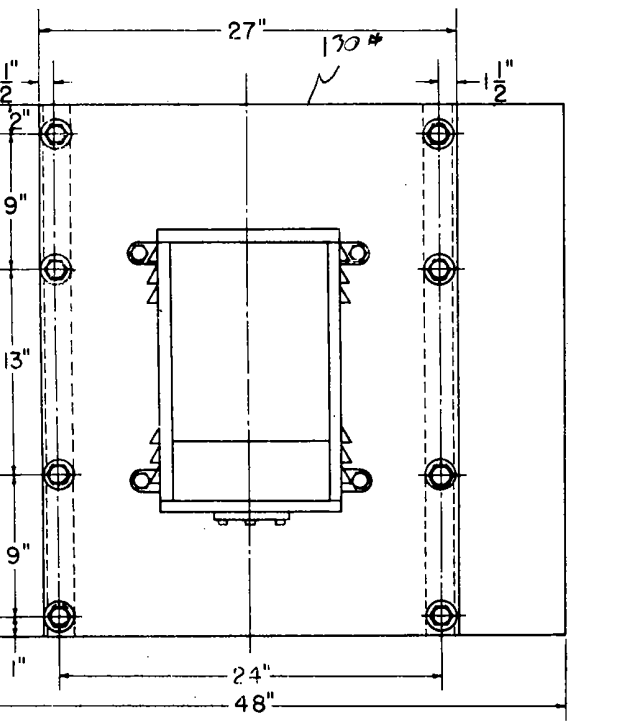
≈ 220 lb w/ bolts

LIST OF MATERIALS (TABLE II)			
QUANTITIES ARE FOR: ONE MOUNTING			
PIECE NO.	ITEM	SIZE	NO. REQ'D
1	CAR BUILDING CHANNEL ✓	4" x 13.8	1
2	CAR BUILDING CHANNEL ✓	4" x 13.8	1
3	AUXILIARY MOUNTING PL. ✓	$\frac{1}{2}$" ✓3	1
4	SPACER ✓	SEE TABLE III	1/BOLT
5	HEX. HD. BOLT ✓2	$\frac{3}{4}$" - 10 x 7" LG.	8
6	HEX. HD. NUT ✓2	$\frac{3}{4}$" - 10 x 7" LG.	8
7	WASHER ✓	2" O.D. x $\frac{13}{16}$" I.D.	16
8	1" STD. PIPE SPACER ✓	$2\frac{15}{16}$" LG.	8

✓1 STEEL

✓2 STEEL (HEAT TREATED)

✓3 SIZE MAY BE INCREASED IN WIDTH ONLY FROM 27" TO A MAXIMUM OF 36" AS REQUIRED FOR LARGE ITEMS OF EQUIPMENT.



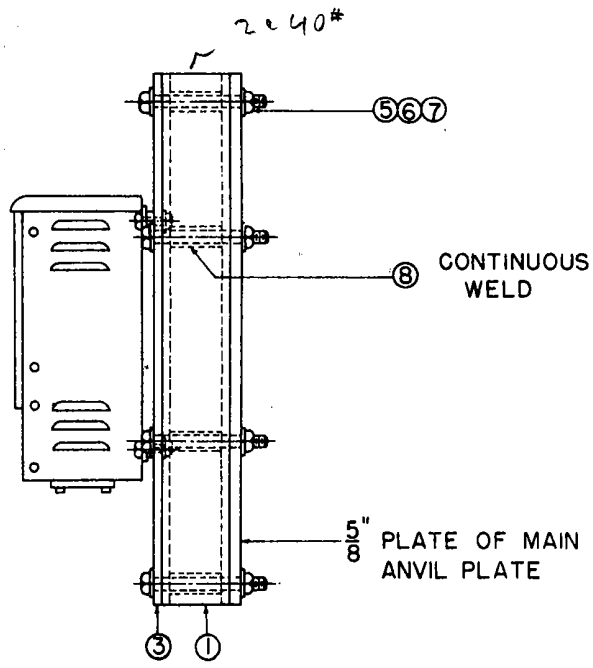
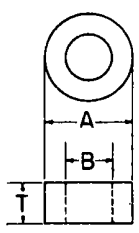


TABLE III

SPACER DIMENSIONS ✓2

BOLT SIZE	DIMENSIONS		
	A	B	T
INCH	INCH	INCH	INCH
$\frac{1}{4}$	$\frac{3}{4}$	$\frac{9}{32}$	$\frac{3}{8}$
$\frac{5}{16}$	$\frac{3}{4}$	$\frac{11}{32}$	$\frac{3}{8}$
$\frac{3}{8}$	$\frac{7}{8}$	$\frac{13}{32}$	$\frac{3}{8}$
$\frac{1}{2}$	$1\frac{1}{4}$	$\frac{9}{16}$	$\frac{1}{2}$
$\frac{5}{8}$	$1\frac{1}{2}$	$\frac{11}{16}$	$\frac{5}{8}$
$\frac{3}{4}$	$1\frac{3}{4}$	$\frac{13}{16}$	$\frac{3}{4}$



FIXTURE 4-A

STANDARD MOUNTING FOR BULKHEAD MOUNTED EQUIPMENT (TYPE "A" TEST LWSM)

FIGURE 5

✓1 SPACERS TO BE USED WHEN SECURING EQUIPMENT TO THE $\frac{1}{2}$" AUXILIARY MOUNTING PANEL (PIECE NO. 3)

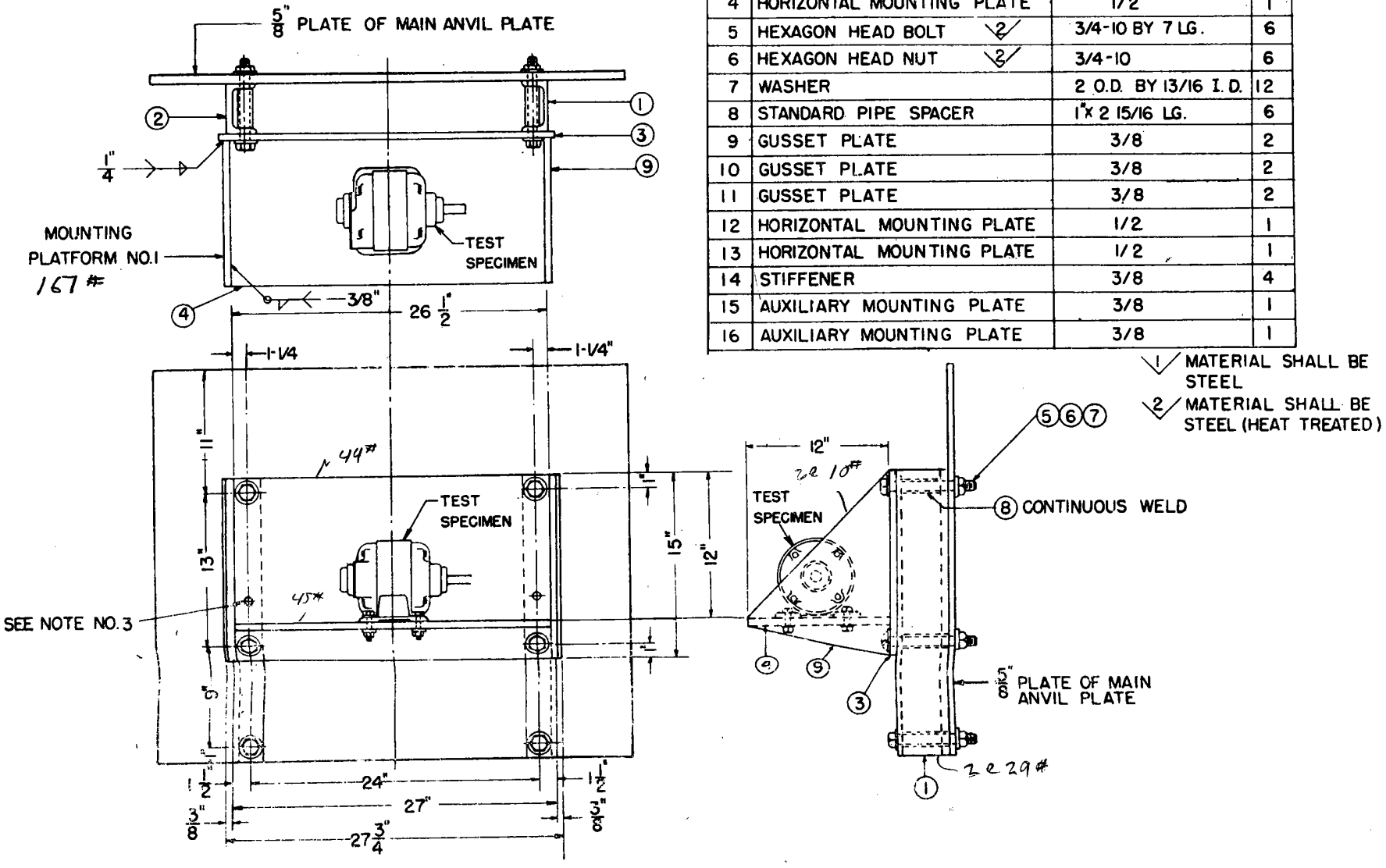
✓2 ONE SPACER SHALL BE USED FOR EACH EQUIPMENT MOUNTING BOLT

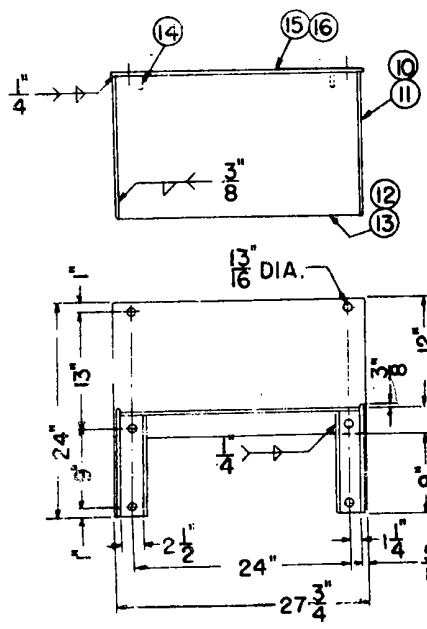
SH 3252-A

TABLE IV LIST OF MATERIAL			
	QUANTITIES ARE FOR 3 MOUNTINGS		
PC NO.	ITEM	SIZE (INCHES)	NO. REQ.
1	CAR BUILDING CHANNEL	4 BY 13.8#	1
2	CAR BUILDING CHANNEL	4 BY 13.8#	1
3	AUXILIARY MOUNTING PLATE	3/8	1
4	HORIZONTAL MOUNTING PLATE	1/2	1
5	HEXAGON HEAD BOLT 2/	3/4-10 BY 7 LG.	6
6	HEXAGON HEAD NUT 2/	3/4-10	6
7	WASHER	2 O.D. BY 13/16 I.D.	12
8	STANDARD PIPE SPACER	1"x 2 15/16 LG.	6
9	GUSSET PLATE	3/8	2
10	GUSSET PLATE	3/8	2
11	GUSSET PLATE	3/8	2
12	HORIZONTAL MOUNTING PLATE	1/2	1
13	HORIZONTAL MOUNTING PLATE	1/2	1
14	STIFFENER	3/8	4
15	AUXILIARY MOUNTING PLATE	3/8	1
16	AUXILIARY MOUNTING PLATE	3/8	1

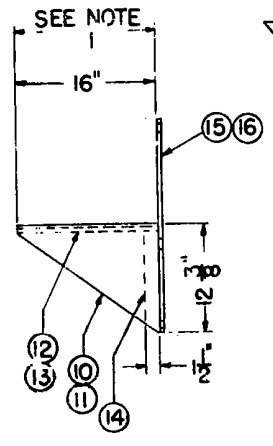
1/ MATERIAL SHALL BE STEEL

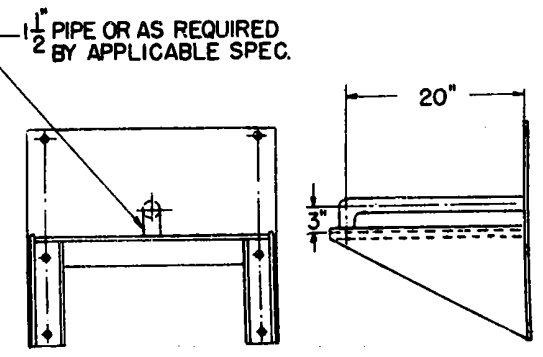
2/ MATERIAL SHALL BE STEEL (HEAT TREATED)





MOUNTING PLATFORM NO. 2





MOUNTING PLATFORM NO. 3 ADAPTED FOR RAIL CLAMP SEARCHLIGHTS

NOTES:

1. THERE ARE 3 MOUNTING PLATFORMS. MOUNTING PLATFORM NO. 3 SHALL BE SIMILAR TO MOUNTING PLATFORM NO. 2 EXCEPT THAT THE DEPTH OF THE HORIZONTAL MOUNTING PLATE AND THE SIDE GUSSET PLATES SHOULD BE INCREASED TO 22 INCHES.
2. THE SMALLEST MTG. PLATFORM SHOULD BE SELECTED WHICH WILL SATISFACTORILY ACCOMMODATE THE EQUIPMENT.
3. IF THE DEEP GUSSETS INTERFERE WITH THE MOUNTING EQUIPMENT, THE EXTRA BOLT HOLES SHOULD BE USED IN BOLTING PLATFORM NO.1 IN THE INVERTED POSITION TO THE FOUR LOWER BOLT HOLES OF THE ANVIL PLATE.

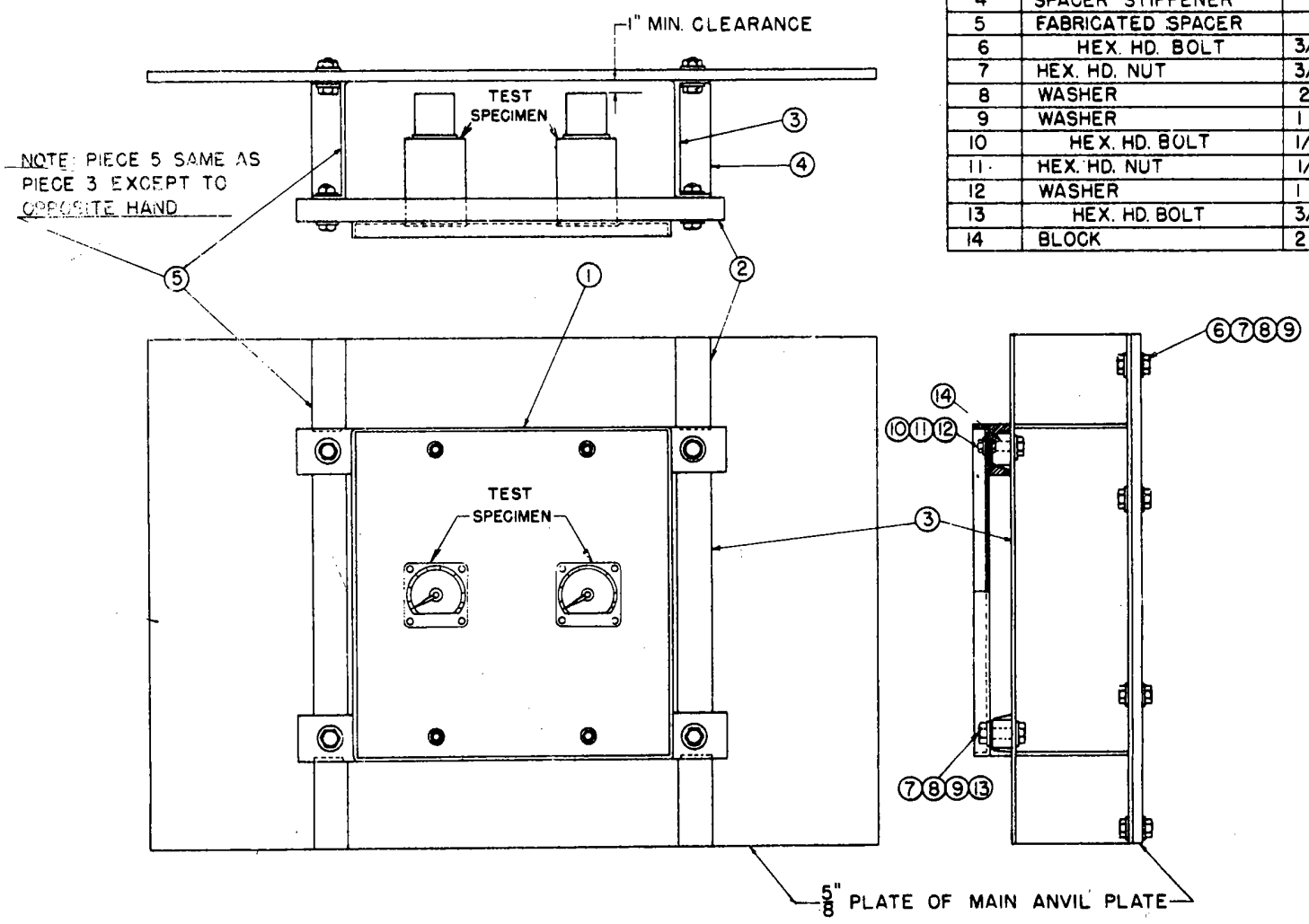
FIXTURE 4-C

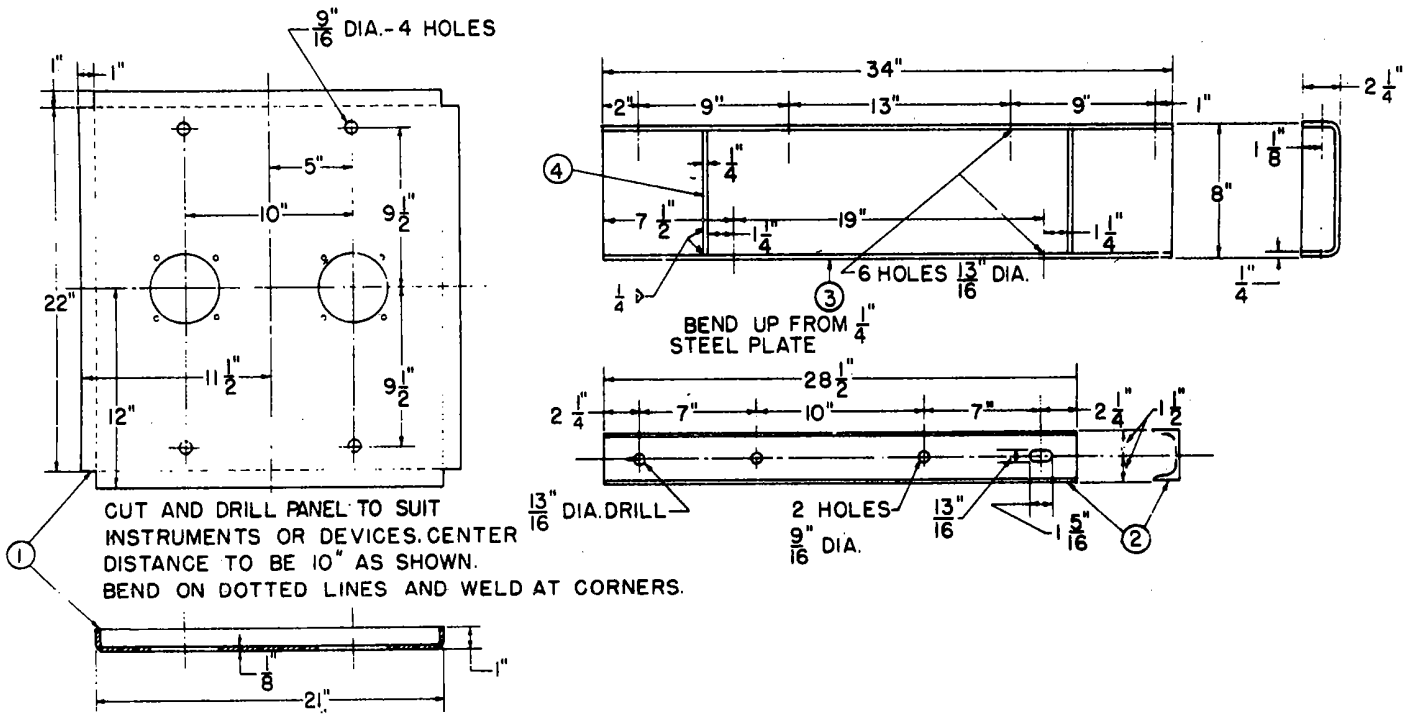
STANDARD MOUNTING FOR DECK OR PLATFORM MOUNTED EQUIPMENT (TYPE "A" TEST LWSM)

FIGURE 6

TABLE V

LIST OF MATERIALS (SEE NOTE 6)			
QUANTITIES ARE FOR: ONE MOUNTING			
PC NO	ITEM	SIZE	NO. REQ'D.
1	PANEL		1
2	STANDARD PANEL	3" x 5"	2
3	FABRICATED SPACER		1
4	SPACER STIFFENER		4
5	FABRICATED SPACER		1
6	HEX. HD. BOLT	3/4"-10 x 1 3/4"	8
7	HEX. HD. NUT	3/4"-10	12
8	WASHER	2" O.D. x 13/16" I.D.	12
9	WASHER	1 3/8" O.D. x 13/16" I.D.	12
10	HEX. HD. BOLT	1/2"- 13 x 1"	4
11	HEX. HD. NUT	1/2"- 13	4
12	WASHER	1 3/8" O.D. x 3/16" I.D.	4
13	HEX. HD. BOLT	3/4"-10 x 2 1/2"	4
14	BLOCK	2 1/2" x 2" x 1 1/4"	4





NOTES:

1. TWO IDENTICAL ITEMS OF EQUIPMENT SHALL BE MOUNTED ON THE PANEL PROVIDED THERE IS A MINIMUM SEPARATION OF 3 INCHES WHERE THE INDICATED 10 INCH CENTERS ARE USED (TOTAL WEIGHT NOT TO EXCEED 40 POUNDS)
2. IF ONLY ONE EQUIP IS TO BE TESTED, A COUNTERBALANCE OF APPROXIMATELY THE SAME WEIGHT SHALL BE MOUNTED IN A CORRESPONDING POSITION ON THE OPPOSITE SIDE OF THE PANEL. MOUNTING DIMENSIONS FOR THE COUNTERBALANCE SHALL BE THE SAME AS FOR THE ITEM OF EQUIPMENT
3. IN THE EVENT THAT THE REQUIREMENTS OF NOTES 1 AND 2 CANNOT BE MET, THE EQUIPMENT SHALL BE MOUNTED CENTRALLY ON THE PANEL. IF THE INDIVIDUAL EQUIPMENT WEIGHT IS IN EXCESS OF 20 POUNDS, THE PANEL SHALL BE REINFORCED AS SHOWN ON FIG. 7-2
4. EQUIPMENT IN EXCESS OF 40 POUNDS SHOULD BE TESTED ON THE PANEL SHOWN ON FIG. 7-2
5. IF THE DEPTH OF THE EQUIPMENT IS SUCH THAT THE MINIMUM CLEARANCE OF 1 INCH CANNOT BE MAINTAINED, THE EQUIPMENT SHOULD BE TURNED AROUND SO THAT THE FRONT FACES THE ANVIL PLATE.
6. MATERIAL SHALL BE STEEL.

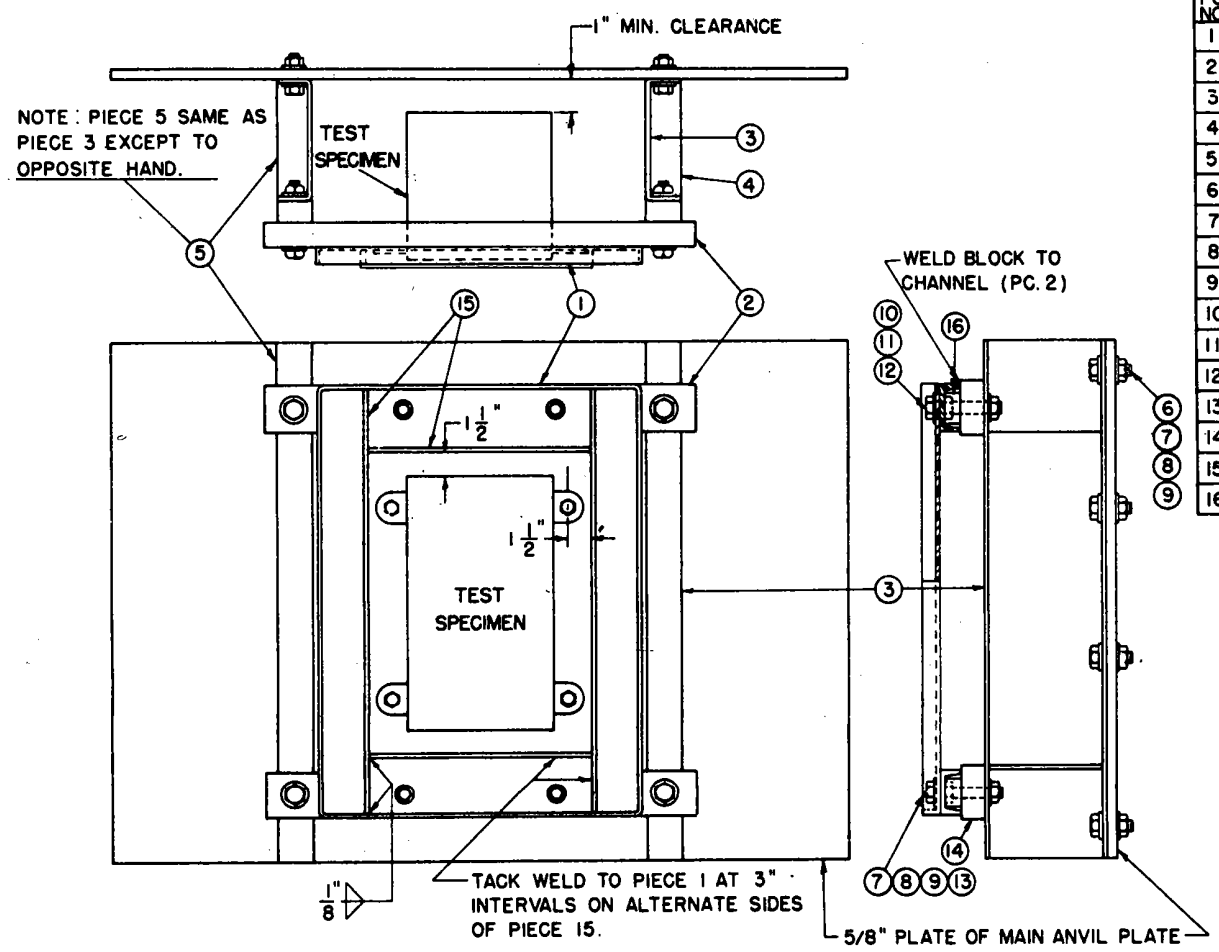
FIXTURE 60-1

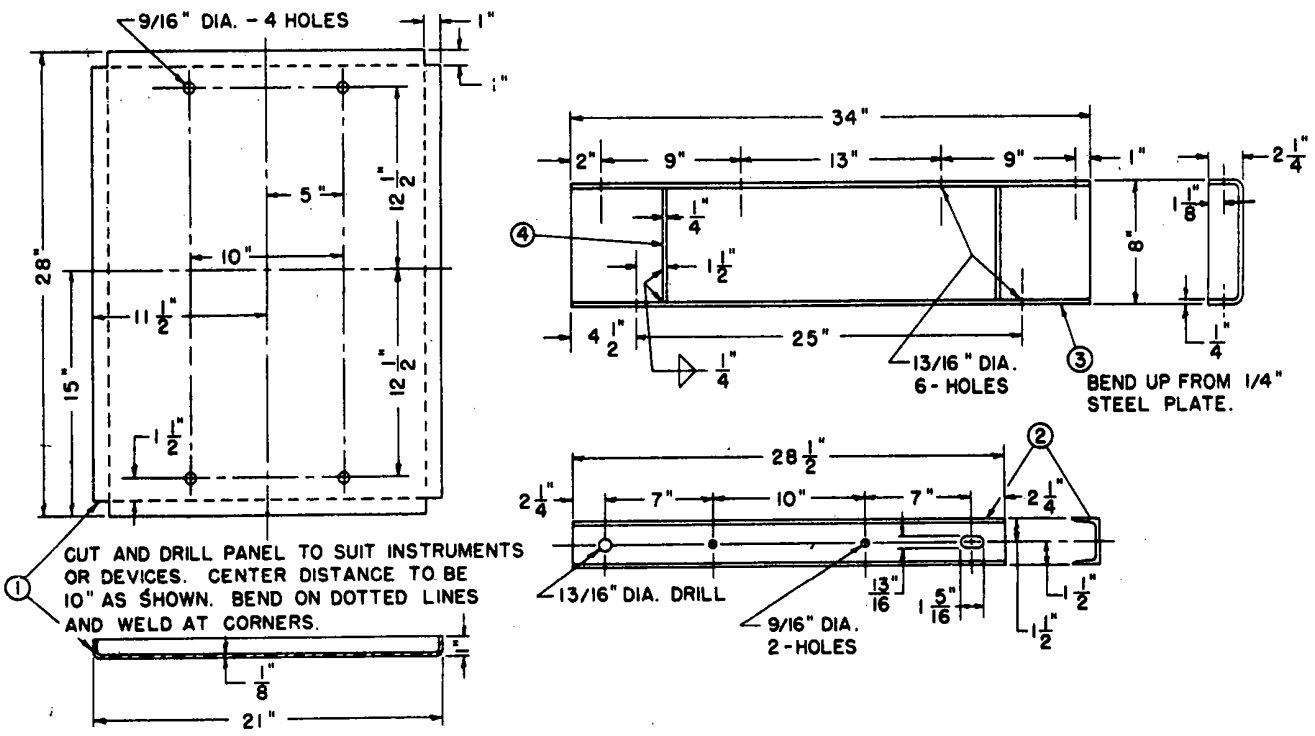
STANDARD MOUNTING FOR ELECTRICAL SWITCHBOARD INSTRUMENTS AND OTHER PANEL MOUNTED EQUIPMENT (TYPE "C" TEST LWSM)

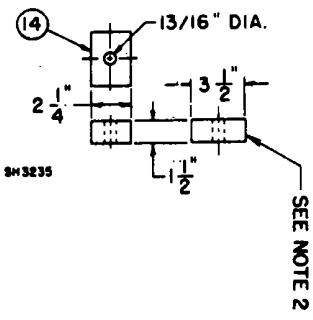
FIGURE 7-1

TABLE VI - LIST OF MATERIAL (SEE NOTE 3)

QUANTITIES ARE FOR ONE MOUNTING			
PC. NO.	ITEM	SIZE (INCHES)	NO. REQ.
1	PANEL		1
2	STANDARD CHANNEL	3" X 5.0#	2
3	FABRICATED SPACER		1
4	SPACER STIFFENER		4
5	FABRICATED SPACER		1
6	HEXAGON HEAD BOLT	3/4"-10 X 1-3/4" LG	8
7	HEXAGON HEAD NUT	3/4"-10	12
8	WASHER	2" O.D. X 13/16" I.D.	12
9	WASHER	1-3/8" O.D. X 13/16" I.D.	12
10	HEXAGON HEAD BOLT	1/2"-13 X 1" LG.	4
11	HEXAGON HEAD NUT	1/2"-13	4
12	WASHER	1-3/8" O.D. X 9/16" I.D	4
13	HEXAGON HEAD BOLT	3/4"-10 X 4" LG.	4
14	SPACER		4
15	STRAP	1/8" X 1"	4
16	BLOCK	2-1/4" X 2" X 1-1/4"	4







NOTES:

1. THIS PANEL IS TO BE USED ONLY IF THE PANEL SHOWN ON FIGURE 7-1 IS NOT APPLICABLE.
2. THE SPACER BLOCKS SHOULD BE USED ONLY WHEN NECESSARY TO MAINTAIN A MINIMUM CLEARANCE OF 1 INCH BETWEEN THE EQUIPMENT AND THE ANVIL PLATE. IF THE DEPTH OF THE EQUIPMENT IS SUCH THAT THE MINIMUM CLEARANCE OF 1 INCH CANNOT BE MAINTAINED, THE SPACER BLOCKS SHOULD BE REMOVED AND THE EQUIPMENT MOUNTED WITH THE FRONT SURFACE TOWARD THE ANVIL PLATE.
3. MATERIAL SHALL BE STEEL.

FIXTURE 60-2

STANDARD MOUNTING FOR ELECTRICAL INDICATING SWITCHBOARD INSTRUMENTS & OTHER PANEL MOUNTED EQUIPMENT (TYPE "C" TEST LWSM)

FIGURE 7-2

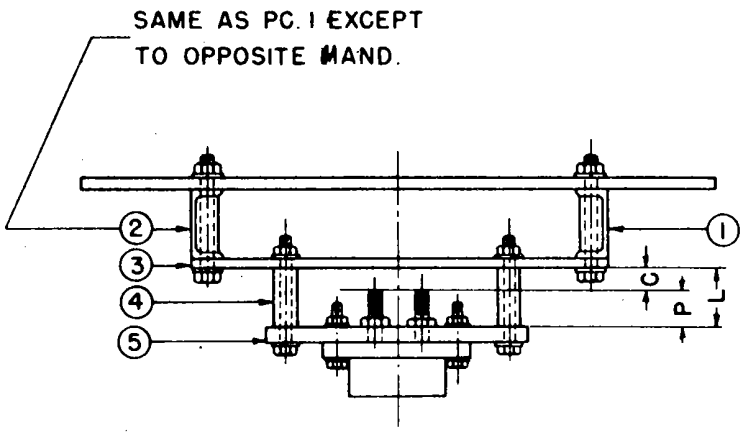
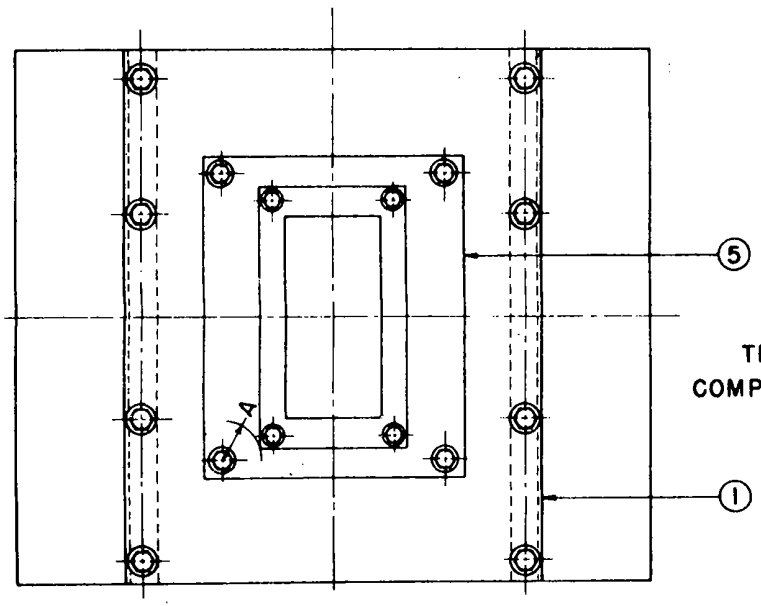


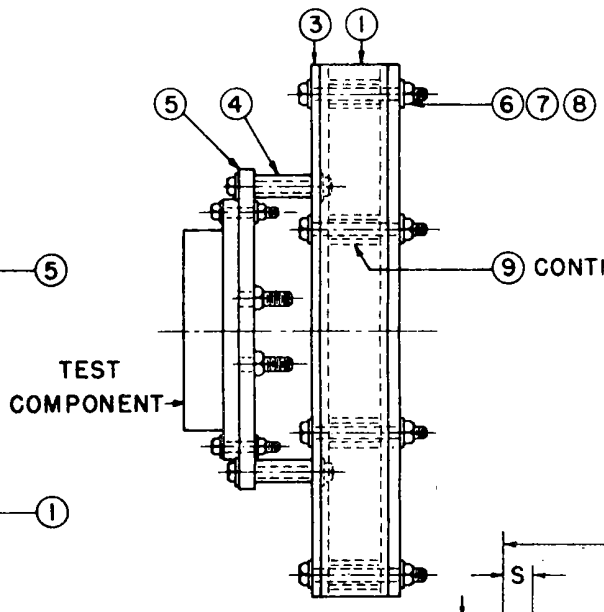
TABLE VII – LIST OF MATERIAL

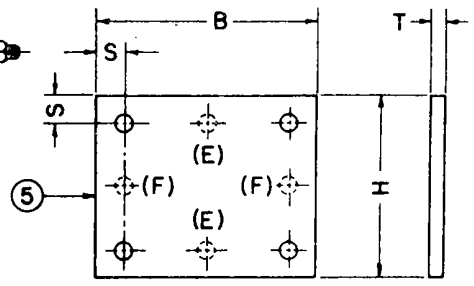
QUANTITIES ARE FOR ONE MOUNTING				
PIECE NO.	ITEM	SIZE	NO. REQ'D	MATERIAL
1	CAR BUILDING CHANNEL	INCHES 4 BY 13.8#	1	STEEL
2	CAR BUILDING CHANNEL	4 BY 13.8#	1	STEEL
3	AUXILIARY PLATE	$\frac{1}{2}$ BY 27 BY 34	1	STEEL
4	SPACER	SEE TABLE VIII	—	STEEL
5	PLASTIC MOUNTING PANEL	SEE TABLE IX	—	LAMINATED (MIL-P-15035)
6	HEXAGON HEAD BOLT	$\frac{3}{4}$ -10 BY 7 LG.	8	STEEL (HEAT-TREATED)
7	HEXAGON HEAD NUT	$\frac{3}{4}$ -10	8	STEEL
8	WASHER	2 O.D. BY $\frac{13}{16}$ I.D.	16	STEEL
9	STANDARD PIPE SPACER	1" IPS x 2 $\frac{15}{16}$ LG.	8	STEEL

11 THE SIZE OF THE AUXILIARY PLATE SHOULD BE INCREASED TO $\frac{1}{2}$ BY 36 BY 34 INCHES FOR PANEL NUMBERS 5 AND 6 LISTED IN TABLE IX



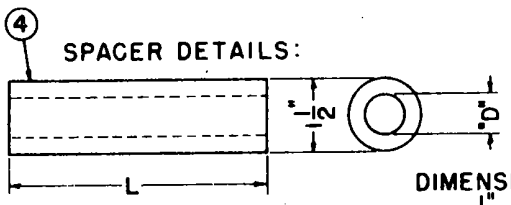
DIMENSION "A", AS MEASURED FROM THE CENTER OF ANY MOUNTING HOLE OF PC. 5 TO THE COMPONENT MOUNTING BASE, SHALL BE NOT LESS THAN $2\frac{1}{2}$ INCHES.





HOLES (E) ARE DRILLED EQUIDISTANT FROM CORNER HOLES ON SAME CENTER LINE-PANEL NO. 5 AND 6 ONLY. HOLES (F) ARE DRILLED EQUIDISTANT FROM CORNER HOLES ON SAME CENTER LINE-PANEL NO. 4 AND 6 ONLY.

4 SPACER DETAILS:



DIMENSION "D" SHALL BE $\frac{17}{32}$" FOR $\frac{1}{2}$" DIA. BOLTS AND $\frac{21}{32}$" FOR $\frac{5}{8}$" DIA. BOLTS.

TABLE VIII – SPACER

WHEN P (NOTE ASSEMBLY PLAN VIEW) IS:		L	NOTES
LESS THAN	GREATER THAN		
INCHES $\frac{3}{4}$	INCHES —	INCHES $1-\frac{1}{2}$	
$3\ \frac{1}{4}$	$\frac{3}{4}$	P + $\frac{3}{4}$	
—	$3\ \frac{1}{4}$	4	CUT OUT $\frac{1}{2}$ INCH THICK AUXILIARY MOUNTING PLATE (PIECE NO. 3) TO GIVE $\frac{3}{4}$ INCH CLEARANCE AROUND REAR PROJECTIONS.

TABLE IX – PANEL SIZE 11, 12

PANEL NO.	B	H	T	S	NO. AND SIZE OF BOLTS	DIAMETER OF BOLT HOLES
1	INCHES 9	INCHES 12	INCHES $\frac{3}{4}$	INCHES 1	4 $\frac{1}{2}$ INCHES BY 13	INCHES $\frac{9}{16}$
2	12	16	1	1	4 $\frac{1}{2}$ INCHES BY 13	$\frac{9}{16}$
3	16	20	1	1	4 $\frac{1}{2}$ INCHES BY 13	$\frac{9}{16}$
4	20	24	1	1	6 $\frac{1}{2}$ INCHES BY 13	$\frac{9}{16}$
5	32	24	1	$1\ \frac{1}{4}$	6 $\frac{5}{8}$ INCHES BY 11	$\frac{11}{16}$
6	36	34	1	$1\ \frac{1}{4}$	6 $\frac{5}{8}$ INCHES BY 11	$\frac{11}{16}$

11 THE PANEL EMPLOYED SHALL BE THE SMALLEST SIZE SHOWN THAT WILL RESULT IN CLEARANCE (NOTE ASSEMBLY FRONT ELEVATION VIEW) OF AT LEAST 2 $\frac{1}{2}$ INCHES.

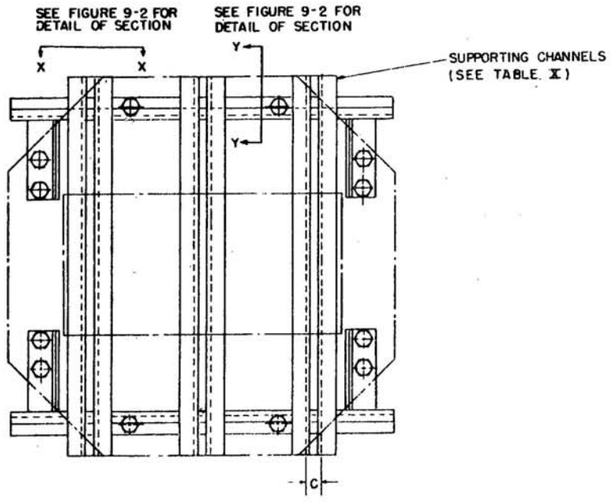
12 THE MANUFACTURER IS TO PROVIDE THE APPROPRIATE PANEL, TOGETHER WITH ALL SPACERS AND MOUNTING FOR BOLTS, WHEN SUBMITTING A COMPONENT TO A NAVAL LABORATORY FOR TEST.

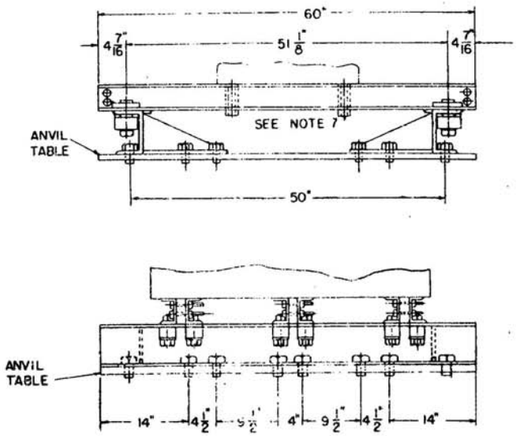
SH 3236

FIXTURE 6E

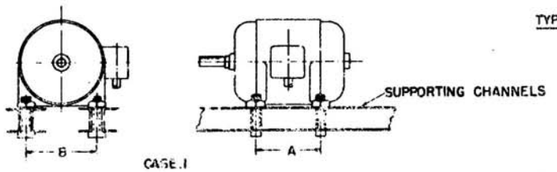
STANDARD MOUNTING FOR ELECTRICAL CONTROLLER COMPONENTS (CONTACTORS, RELAYS, RESISTORS, ETC) (TYPE "C" TEST LWSM)

FIGURE 8



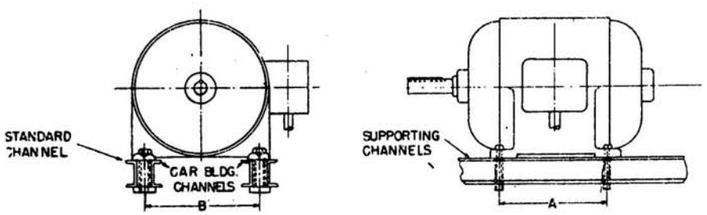


TYPICAL MOUNTING ARRANGEMENTS

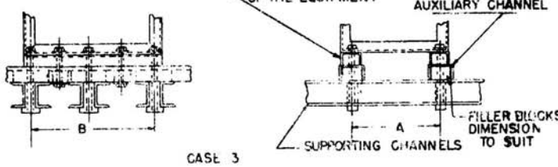


CASE 1

FOR EQUIPMENT REQUIRING TWICE THE NUMBER OF SUPPORTING CHANNELS AS THE NUMBER OF PARALLEL LINES OF MOUNTING BOLT HOLES.

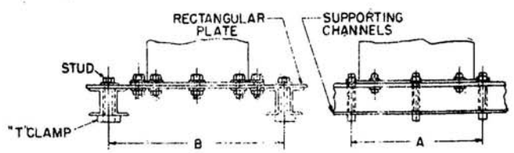


CASE 2
(SEE NOTE-10)



CASE 3

FOR EQUIPMENT REQUIRING FULL SUPPORT ALONG ENTIRE BASE



CASE 4
(SEE NOTE-11)

NOTES:

1 DIMENSIONS 'A' AND 'B' ARE THE EXTREME BOLT HOLE CENTER DISTANCES OF THE EQUIPMENT WITH DIMENSION 'B' ALWAYS EQUAL TO OR GREATER THAN DIMENSION 'A'

2 THE APPROPRIATE NUMBER OF SUPPORTING CHANNELS SHALL BE SELECTED IN ACCORDANCE WITH THE WEIGHT AND DIMENSION 'A' OF THE EQUIPMENT. (SEE TABLE X)

3 WHEN SELECTING SUPPORTING CHANNELS FOR WEIGHT AND DIMENSION 'A' NOT LISTED IN TABLE X THE NEXT HIGHER WEIGHT VALUE AND THE SMALLER DIMENSION 'A' SHALL BE USED.

4 WHEN SELECTING THE SUPPORTING CHANNELS FOR CASES 3 AND 4 LISTED IN TABLE X, THE WEIGHT OF THE AUXILIARY CHANNELS OR PLATES SHOULD BE INCLUDED IN THE EQUIPMENT WEIGHT.

5 TWO STANDARD 4" BY 7.25" CHANNELS HAVE A COMBINED STRENGTH EQUIVALENT TO A SINGLE 4" BY 13.8" CAR BUILDING CHANNEL AND MAY BE USED IN PLACE OF, OR IN CONJUNCTION WITH, THE CAR BUILDING CHANNELS.

6. WHEN USING STANDARD OR CAR BUILDING CHANNELS BACK TO BACK THE ENDS OF THE CHANNELS SHOULD BE CLAMPED WITH THE SPACER, PG. 9, AND BOLTS SHOWN ON FIGURE 9-2.

7. HOLES SHOULD NOT BE DRILLED THROUGH THE FLANGES OF THE SUPPORTING CHANNELS FOR THE PURPOSE OF BOLTING EQUIPMENT. EQUIPMENT SHOULD BE BOLTED TO THE SUPPORTING CHANNELS BY MEANS OF THE T CLAMP SHOWN ON FIGURE 9-2.

8. THE SPACING OF THE SUPPORTING CHANNELS ON THE SHIPBUILDING CHANNELS SHOULD BE GOVERNED, WHEN PRACTICABLE, BY THE POSITION OF THE CENTER OF GRAVITY TO OBTAIN UNIFORM DISTRIBUTION OF LOAD.

9. IF THE EQUIPMENT MOUNTING FEET ARE NOT SUBSTANTIALLY WIDER THAN DIMENSION 'C', A STEEL PAD SHOULD BE USED BETWEEN THE FEET AND SUPPORTING CHANNELS AT EACH MOUNTING BOLT AND CLAMP.

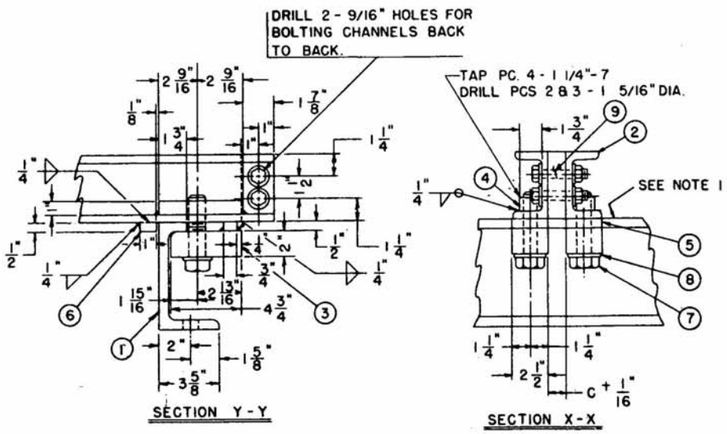
10. FOR EQUIPMENT REQUIRING TWO OR MORE CAR BUILDING SUPPORTING CHANNELS, ALL OR PART OF THE NUMBER OF CAR BUILDING CHANNELS AS INDICATED IN TABLE X MAY BE REPLACED WITH STANDARD CHANNELS TO UTILIZE A BACK TO BACK CHANNEL ARRANGEMENT - NOTE 7. IN THE EVENT THAT THE REQUIRED NUMBER OF SUPPORTING CHANNELS DOES NOT LEND ITSELF TO THIS METHOD, THE AUXILIARY CHANNEL ARRANGEMENT OF CASE 3 SHOULD BE USED.

11. FOR EQUIPMENT HAVING AN IRREGULAR OR CIRCULAR MOUNTING BOLT HOLE PATTERN (UTILIZE "T" CLAMPS OF SUFFICIENT SIZE AND NUMBER TO PROVIDE TOTAL BOLTING STRENGTH AT LEAST 50 PERCENT GREATER THAN PROVIDED BY EQUIPMENT BOLTS.)

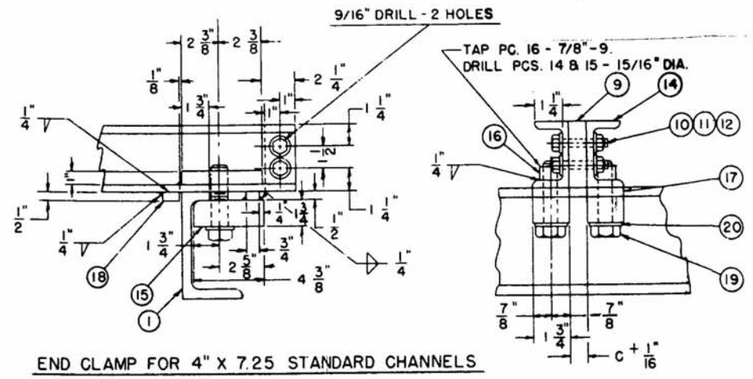
TABLE X; NUMBER OF SUPPORTING 4" CAR BUILDING CHANNELS REQUIRED FOR A GIVEN EQUIPMENT WEIGHT & SIZE

WEIGHT OF EQUIPMENT (SEE NOTE 4) LBS	CENTER DISTANCE BETWEEN BOLT HOLES DIMENSION "A" (INCHES)																				
	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44
500	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
600	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
700	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
800	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2
900	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2
1000	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2
1100	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	2
1200	4	4	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2
1300	5	5	4	4	4	4	4	3	3	3	3	2	2	2	2	2	2	2
1400	5	5	5	4	4	4	4	4	3	3	3	3	2	2	2	2	2	2
1500	5	5	5	5	5	4	4	4	3	3	3	3	3	2	2	2	2	2
1600	6	5	5	5	5	4	4	4	4	3	3	3	3	2	2	2	2	2
1700	6	6	6	5	5	5	4	4	4	4	3	3	3	3	3	3	3	3
1800	6	6	6	6	5	5	5	4	4	4	4	3	3	3	3	3	3	3
1900	7	6	6	6	6	5	5	5	4	4	4	3	3	3	3	3	3	3
2000	7	7	6	6	6	5	5	5	4	4	4	4	3	3	3	3	3	3
2100	7	7	7	6	6	6	5	5	5	4	4	4	3	3	3	3	3	3
2200	8	7	7	7	6	6	6	5	5	5	4	4	4	3	3	3	3	3
2300	8	8	7	7	7	6	6	6	5	5	5	4	4	4	3	3	3	3
2400	8	8	8	7	7	7	6	6	6	5	5	5	4	4	4	3	3	3
2500		8	8	7	7	7	6	6	6	5	5	5	4	4	4	4	4	4
2600			8	8	7	7	7	6	6	6	5	5	4	4	4	4	4	4
2700				8	8	7	7	6	6	6	5	5	5	4	4	4	4	4
2800				8	8	7	7	7	6	6	6	5	5	4	4	4	4	4
2900					8	8	7	7	6	6	6	5	5	4	4	4	4	4
3000					8	8	7	7	6	6	6	6	5	5	4	4	4	4
3100						8	8	7	7	6	6	6	5	5	4	4	4	4
3200						8	8	7	7	6	6	6	5	5	4	4	4	4
3300							8	8	7	7	6	6	5	5	5	5	5	5
3400							8	8	7	7	6	6	5	5	5	5	5	5
3500								8	8	7	6	6	5	5	5	5	5	5
3600								8	8	7	6	6	5	5	5	5	5	5
3700								8	8	7	6	6	5	5	5	5	5	5
3800								9	8	7	7	6	5	5	5	5	5	5
3900								9	8	7	7	6	6	5	5	5	5	5
4000								9	8	8	7	6	6	5	5	5	5	5
4100								9	8	8	7	6	6	6	6	6	6	6
4200								9	9	8	7	7	6	6	6	6	6	6
4300								10	9	8	7	7	6	6	6	6	6	6
4400								10	9	8	8	7	6	6	6	6	6	6
4500								10	9	9	8	7	6	6	6	6	6	6
4600								10	9	9	8	7	7	6	6	6	6	6
4700								10	9	9	8	7	7	6	6	6	6	6
4800									10	9	8	8	7	7	6	6	6	6
4900									10	9	8	8	7	7	7	7	7	7
5000									10	9	8	8	7	7	7	7	7	7
5100									10	10	9	8	7	7	7	7	7	7
5200									10	10	9	8	8	7	7	7	7	7
5300										10	9	8	8	7	7	7	7	7
5400										10	9	9	8	7	7	7	7	7
5500										10	9	9	8	7	7	7	7	7
5600										10	9	9	8	8	7	7	7	7
5700											10	9	9	8	8	8	8	8
5800											10	9	9	8	8	8	8	8
5900											10	9	9	8	8	8	8	8
6000											10	10	9	9	8	8	8	8

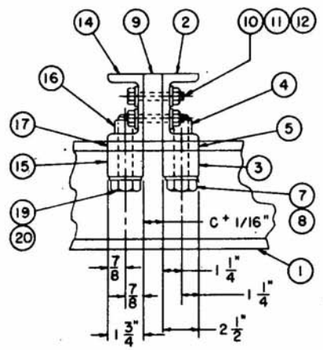
FIGURE 9-1
STANDARD MOUNTING PLATFORM FOR TESTING EQUIPMENT ON MEDIUM WEIGHT SHOCK TESTING MACHINE.



END CLAMP FOR 4" X 13.8 CAR BUILDING SUPPORTING CHANNELS



END CLAMP FOR 4" X 7.25 STANDARD CHANNELS



END CLAMP FOR CAR BUILDING SUPPORTING CHANNEL AND STANDARD CHANNEL COMBINED.

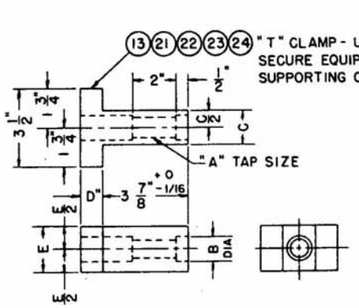
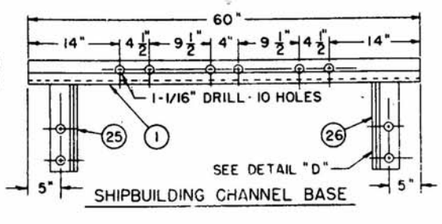


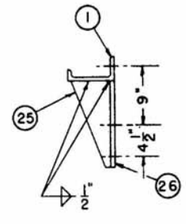
TABLE XII - CLAMP DIMENSIONS (INCHES)

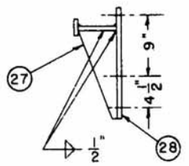
PC. NO.	A	B	C	D	E
13	1/2"-13	9/16"	1 1/8"	3/4"	1 1/8"
21	5/8"-11	11/16"	1 1/8"	3/4"	1 1/8"
22	3/4"-10	13/16"	1 1/4"	7/8"	1 1/2"
23	7/8"-9	15/16"	1 3/8"	15/16"	1 3/4"
24	1" -8	1 1/16"	1 1/2"	1"	2"

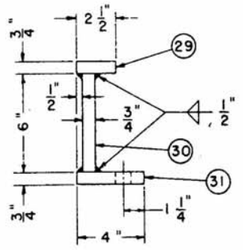


SHIPBUILDING CHANNEL BASE

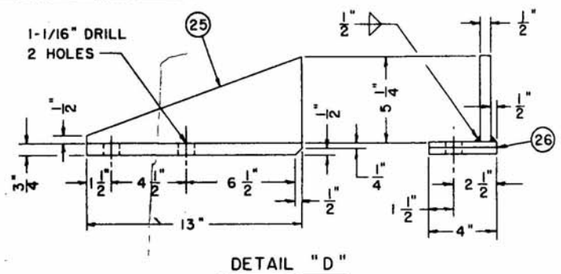
FABRICATED CHANNEL BASE





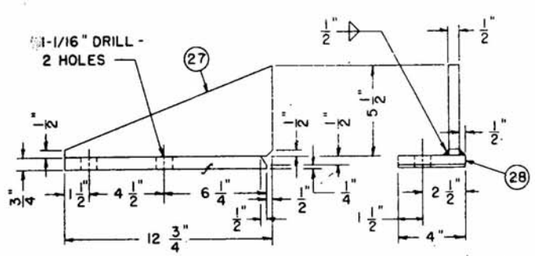


SECTION "F-F"



DETAIL "D"

DETAIL OF BRACE FOR SHIPBUILDING CHANNEL



DETAIL "E"

DETAIL OF BRACE FOR FABRICATED CHANNEL

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TABLE XI - LIST OF MATERIAL √

PC. NO.	ITEM	SIZE (INCHES)	NO. REQ.
1	SHIPBUILDING CHANNEL	7 X 22.7*	2
2	CARBUILDING CHANNEL	4 X 13.8*	A/R
3	CLAMP	2"X2 1/2"X 4 3/4"	A/R
4	BLOCK	1" X 1 3/4" X 5 1/8"	A/R
5	PAD	1/2"X 3/4" X 2 1/2"	A/R
6	PAD	1/2"X 1" X 2"	A/R
7	HEXAGON HEAD BOLT	1 1/4"-7 X 4 1/4"LG.	A/R
8	WASHER	1 3/8" I.D. X 2 5/16" O.D.	A/R
9	SPACER	2" X 4" X A/R	A/R
10	HEXAGON HEAD BOLT	1/2"-13 X A/R	A/R
11	WASHER	9/16" I.D. X 1" O.D.	A/R
12	HEXAGON HEAD NUT	1/2"-13	A/R
13	CLAMP	SEE TABLE XII	A/R
14	STANDARD CHANNEL	4" X 7.25*	A/R
15	CLAMP	1 3/4" X 1 3/4" X 4 3/8"	A/R
16	BLOCK	1" X 1 1/4" X 4 3/4"	A/R
17	PAD	1/2" X 3/4" X 1 3/4"	A/R
18	PAD	1/2" X 1" X 1 1/4"	A/R
19	HEXAGON HEAD BOLT	7/8"-9 X 3 5/8" LG.	A/R
20	WASHER	15/16" I.D. X 1 9/16" O.D.	A/R
21	CLAMP	SEE TABLE XII	A/R
22	CLAMP	SEE TABLE XII	A/R
23	CLAMP	SEE TABLE XII	A/R
24	CLAMP	SEE TABLE XII	A/R
25	GUSSET	1/2" X 5 1/4" X 13"	A/R
26	PLATE	3/4" X 4" X 13"	A/R
27	GUSSET	1/2" X5 1/2" X12 3/4"	A/R
28	PLATE	7/8" X 4" X 12 1/4"	A/R
29	PLATE	7/8" X 2 1/2" X 60"	A/R
30	PLATE	3/4" X 6" X 60"	A/R
31	PLATE	7/8" X 4" X 60"	A/R

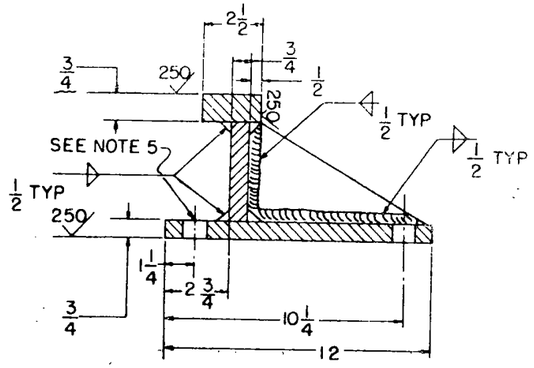
√ MATERIAL SHALL BE STEEL

NOTES:

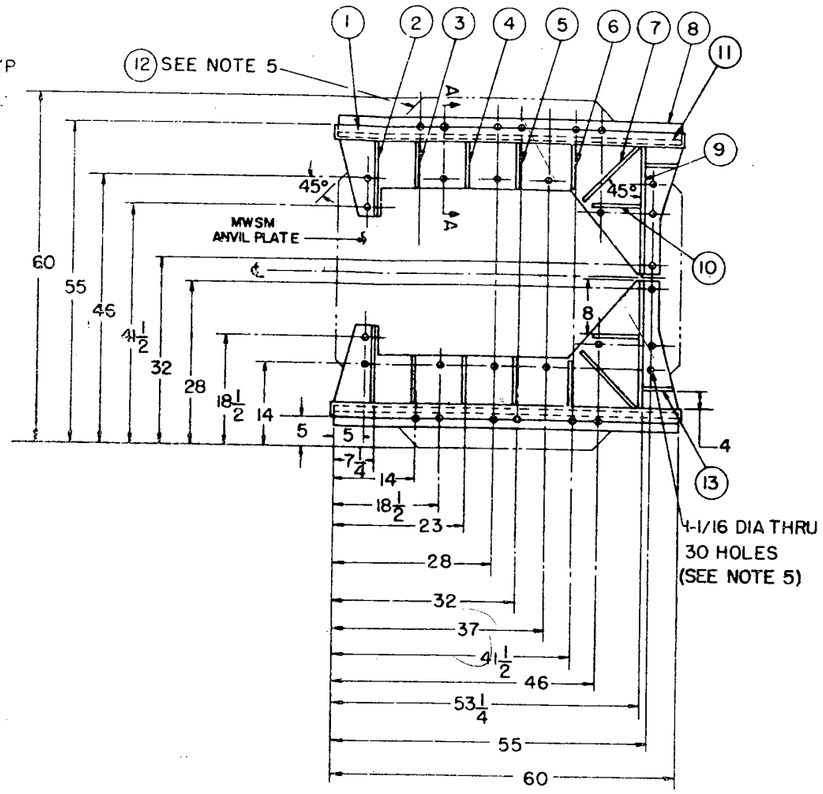
1. TOP FLANGE OF PC. NO. 1 SHALL BE BURNED OR CUT OFF TO A WIDTH OF 1 3/4"
2. PC. NOS. 3 AND 4 SHALL BE SHAPED TO FIT INNER SURFACES OF PC. NOS. 1 AND 2 RESPECTIVELY. (SEE NOTE 5)
3. PC. NOS. 15 AND 16 SHALL BE SHAPED TO FIT INNER SURFACES OF PC. NOS. 1 AND 14 RESPECTIVELY. (SEE NOTE 5)
4. USE OF EITHER PC. NO. 1 OR THE FABRICATED CHANNEL, SECTION "F-F" OF FIG 9-2 IS OPTIONAL DEPENDENT UPON AVAILABILITY OF MATERIAL OR EASE OF FABRICATION.
5. IF THE FABRICATED CHANNEL, SECTION "F-F" IS USED, PC. NOS. 3 AND 15 SHOULD BE SHAPED TO FIT THE INNER SURFACE OF THE FABRICATED CHANNEL, SECTION "F-F", RATHER THAN PC. NO. 1. PC. NOS. 6 AND 18 SHALL EACH BE SHIFTED INWARD 3/4".
6. USE OF BACK TO BACK SUPPORTING CHANNELS WHICH ARE PERMANENTLY WELDED TOGETHER AT THE ENDS RATHER THAN BOLTED TOGETHER, IS OPTIONAL.

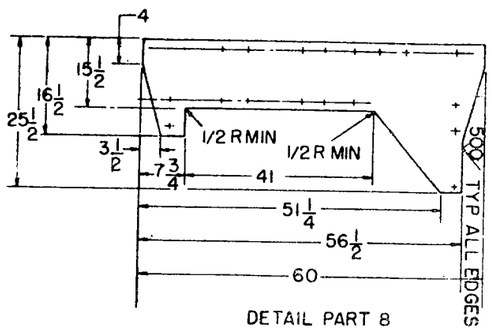
FIGURE 9-2

STANDARD MOUNTING PLATFORM FOR TESTING EQUIPMENT ON MEDIUM WEIGHT SHOCK TESTING MACHINE



SECTION A-A





DETAIL PART 8

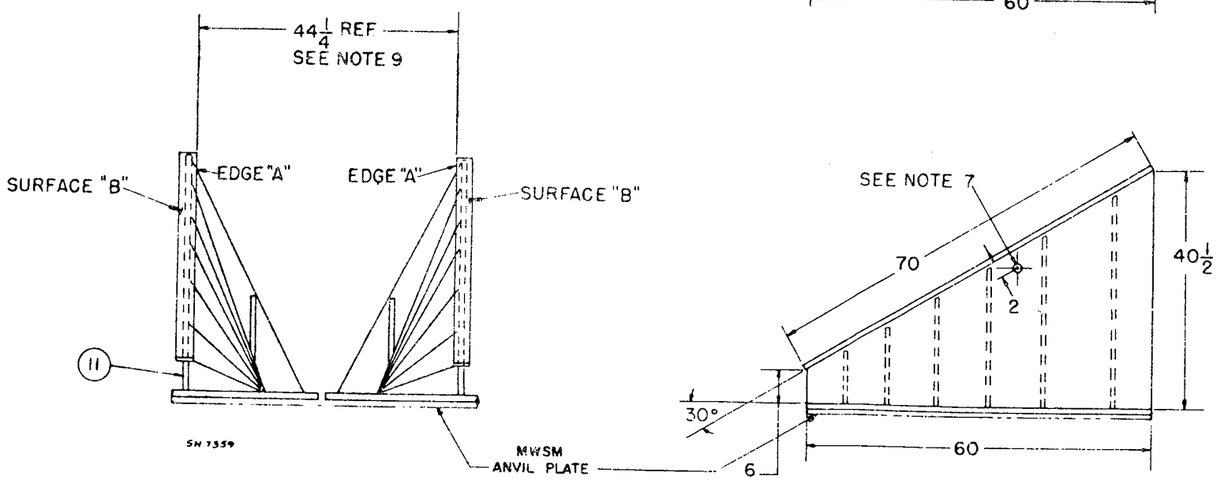


TABLE XIII - LIST OF MATERIALS

PIECE NO.	SIZE	MATERIAL	NO. REQUIRED
1	1 X 4 X 70	HRS 1010	2
2	1/2 X 9 X 12-1/2		2
3	1/2 X 8 X 13-1/2		2
4	1/2 X 8 X 18-1/2		2
5	1/2 X 8 X 29-1/2		2
6	1/2 X 8 X 29		2
7	1/2 X 22 X 36		2
8	1 X 52 X 60		2
9	1/2 X 22 X 36		2
10	1/2 X 7 X 6-1/2		2
11	3/4 X 60 X 40-1/2	HRS 1010	2
12	1/4 X 30 X 60	61 ST	2
13	1/2 X 5 X 27	HRS 1010	2

NOTES:

1. THIS FIXTURE WHEN USED, REPLACES THE SHIPBUILDING OR FABRICATED CHANNELS SHOWN ON FIGURES 9-1 & 9-2. EQUIPMENT AND SUPPORTING CHANNELS ARE MOUNTED TO THIS FIXTURE AS SHOWN ON FIGURE 9-1.
2. SEE FIGURE 10-2 FOR 30 DEGREE MOUNTING PLATFORM FOR BULKHEAD SUPPORTED EQUIPMENT.
3. FULLY ANNEAL ASSEMBLY AFTER WELDING.
4. FINISH MACHINE AFTER ANNEALING.
5. PIECE NO. 12 IS NOT A PART OF THE FIXTURE. IT IS A TEMPLATE HAVING A HOLE PATTERN IDENTICAL TO THE H.I. SHOCK TEST MACHINE PLATFORM. LOCATE ALL 1-1/16" DIA. HOLES FROM SHOCK MACHINE PLATFORM.
6. ALL WELDS TO BE 1/2 INCH COMPLETELY AROUND EACH EDGE
7. TWO INCH DIAMETER HOLE SHALL BE TORCH CUT AFTER WELDING. THE HOLE SHALL BE LOCATED NEAR THE CENTER OF GRAVITY.
8. ALL EDGES AND CORNERS SHALL BE BROKEN SUITABLE FOR HANDLING.
9. PARALLELISM SHALL BE MAINTAINED AT SURFACES "B" AND EDGES "A" WITHIN 1/32 INCH.

30° MOUNTING FIXTURE FOR TESTING BASE MOUNTED EQUIPMENT ON MEDIUM WEIGHT SHOCK TESTING MACHINE.

FIGURE 10-1

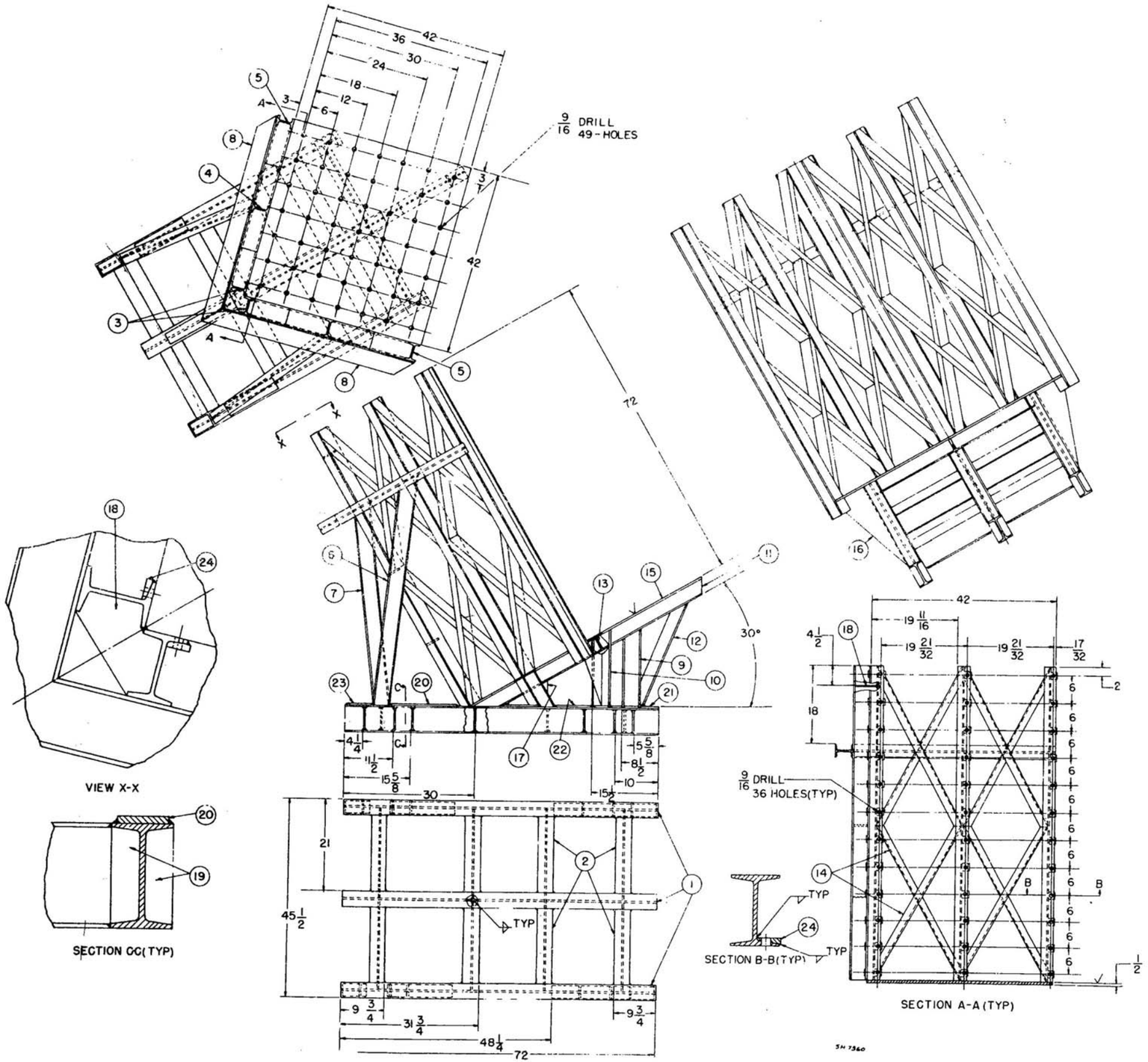


TABLE XIV LIST OF MATERIAL V, 2

PIECE NO	ITEM	SIZE INCHES	LENGTH INCHES	NO REQUIRED
1	H-BEAM	60 X 3-1/2 X 025 WEB	72	3
2	H-BEAM	60 X 3-1/2 X 025 WEB	20-3/4	8
3	H-BEAM	40 X 2-5/8 X 025 WEB	74	2
4	H-BEAM	40 X 2-5/8 X 025 WEB	82	2
5	H-BEAM	40 X 2-5/8 X 025 WEB	75	2
6	H-BEAM	40 X 2-5/8 X 025 WEB	52	2
7	H-BEAM	40 X 2-5/8 X 025 WEB	45	1
8	H-BEAM	40 X 2-5/8 X 025 WEB	50	2
9	H-BEAM	40 X 2-5/8 X 025 WEB	17-1/2	1
10	H-BEAM	40 X 2-5/8 X 025 WEB	16-3/4	2
11	T-BEAM	30 X 30 X 025 WEB	59	1
12	T-BEAM	30 X 30 X 025 WEB	24-3/4	1
13	T-BEAM	30 X 30 X 025 WEB	20-3/4	2
14	CHANNEL	40 X 1-3/4 X 025 WEB	41	16
15	PLATE	5/8 X 42	42	1
16	STIFFENER	3/8 X 80	15	2
17	STIFFENER	3/8 X 5-1/2	15	1
18	STIFFENER	3/8 X 5-1/4	5-1/4	4
19	STIFFENER	3/8 X 1-5/8	5-1/2	24
20	PAD	3/8 X 30	14-3/4	2
21	PAD	3/8 X 30	10-3/4	2
22	PAD	3/8 X 30	8-1/4	2
23	PAD	3/8 X 30	6	2
24	PAD	3/8 X 1-1/2	1-1/2	72

V MATERIAL FOR PIECE NUMBERS 1 THROUGH 14 SHALL BE IN ACCORDANCE WITH TYPE A, GRADE M OF MIL-S-20166

2 MATERIAL FOR PIECE NUMBERS 15 THROUGH 24 SHALL BE IN ACCORDANCE WITH TYPE I, GRADE M OF MIL-S-16113

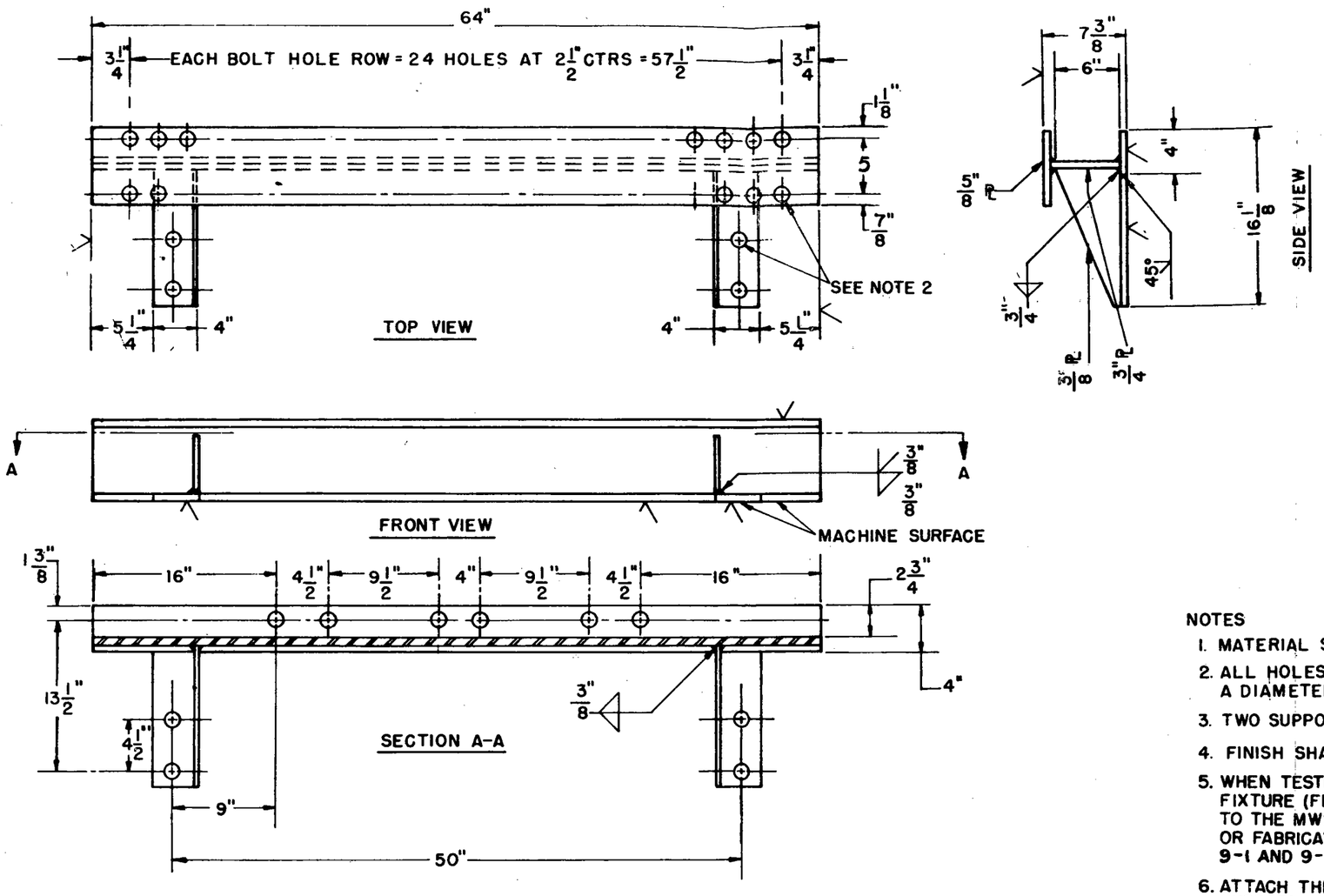
NOTES.

1. UNLESS OTHERWISE SPECIFIED HEREIN OR IN THE INDIVIDUAL EQUIPMENT SPECIFICATION, SURFACE ROUGHNESS, AS ROLLED OR DRAWN, PUNCH CUT OR MACHINED SHALL HAVE A 250 FINISH AND SHALL BE IN ACCORDANCE WITH MIL-STD-10
2. THREADS SHALL BE IN ACCORDANCE WITH H 28 AND MIL-STD-9.
3. UNLESS OTHERWISE SPECIFIED HEREIN OR IN THE INDIVIDUAL EQUIPMENT SPECIFICATION, ALL FILLET WELDS SHALL BE 1/4 INCH
4. MACHINED SURFACES SHALL NOT BE PAINTED.
5. FABRICATION PROCEDURES AND INSPECTION STANDARDS FOR WELDING SHALL BE IN ACCORDANCE WITH CLASS I OF MIL-W-21157 WELD SHALL BE THE MANUAL SHIELDED ARC PROCESS USING WELDING ELECTRODE TYPE 7018 OF MIL-E-22200/1.
6. STRESS RELIEF SHALL BE AT 1175°± 25°F FOR A MINIMUM OF 3 HOURS, THEN THE FURNACE SHALL BE COOLED.
7. WELDING SYMBOLS SHALL BE AS SPECIFIED IN MIL-STD-19.
8. WELDING TERMS AND DEFINITIONS SHALL BE IN ACCORDANCE WITH MIL-STD-20.
9. WELDED-JOINT DESIGNS SHALL BE AS SPECIFIED IN MIL-STD-22
10. DIMENSIONS AND TOLERANCES SHALL BE AS SPECIFIED IN MIL-STD-8.
11. THIS FIXTURE IS ATTACHED TO THE ANVIL PLATE OF THE MWSM BY MEANS OF SUPPORTS SHOWN ON FIGURE 11 AND CLAMPS SHOWN ON FIGURE 12.

30° MOUNTING FIXTURE FOR TESTING
BULKHEAD MOUNTED EQUIPMENT
ON MEDIUM WEIGHT SHOCK TESTING MACHINE

FIGURE 10-2

data ref w/ base 2650 lbs



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NOTES

1. MATERIAL SHALL BE STEEL.
2. ALL HOLES SHALL BE DRILLED TO A DIAMETER OF 1-1/16 INCH DIAMETER.
3. TWO SUPPORTS SHALL BE REQUIRED.
4. FINISH SHALL BE 125.
5. WHEN TESTING EQUIPMENT ON THE 30° MOUNTING FIXTURE (FIG. 10-2), THESE SUPPORTS ARE ATTACHED TO THE MWSM ANVIL PLATE IN PLACE OF THE SHIPBUILDING OR FABRICATED CHANNEL BASES SHOWN ON FIGURES 9-1 AND 9-2
6. ATTACH THE 30° MOUNTING FIXTURE (FIG. 10-2) TO THESE SUPPORTS BY MEANS OF CLAMPS SHOWN ON FIGURE 12.

SUPPORTS

FOR 30° MOUNTING FIXTURE

FOR TESTING BULKHEAD MOUNTED EQUIPMENT (MWSM)

FIGURE 11

FIGURE 12-1 CLAMP

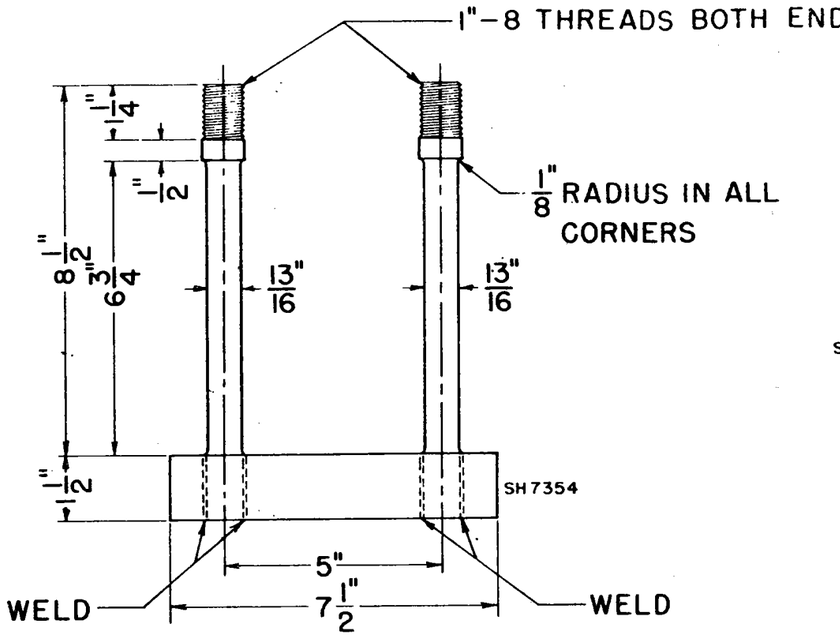


FIGURE 12-4 TOP PLATE

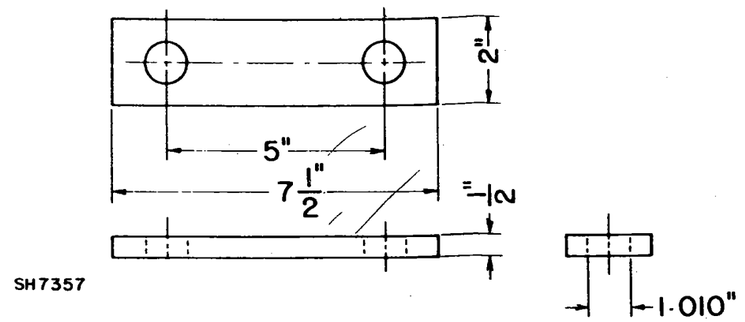


FIGURE 12-3 WASHER

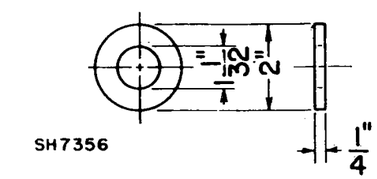
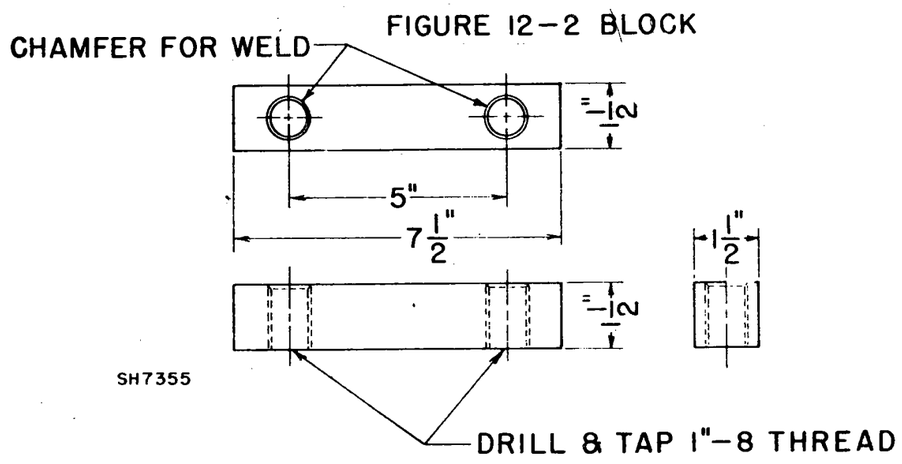


FIGURE 12-2 BLOCK



NOTES:

1. MATERIAL SHALL BE 4340 STEEL
2. TOLERANCES SHALL BE PLUS OR MINUS 0.010 INCH
3. NUMBER OF CLAMPS, WASHERS, STUDS, BLOCKS, TOP PLATES, AND NUTS REQUIRED ARE AS FOLLOWS:
   - 4-CLAMPS
   - 8-WASHERS
   - 8-STUDS
   - 4-BLOCKS
   - 4-TOP PLATES
   - 8-1 INCH-8NC ESNA NUTS

FIGURE 12 - CLAMPS

FOR 30° MOUNTING FIXTURE (FIG. 10-2) & SUPPORTS

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